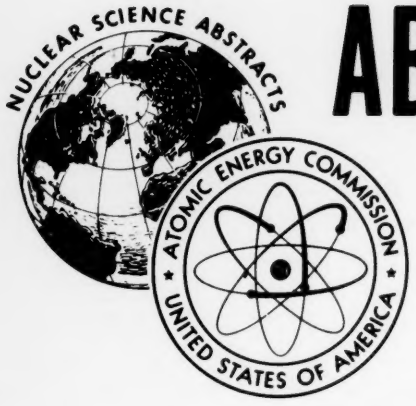
NUCLEAR SCIENCE ABSTRACTS



Volume 28 Number 6

Abstracts 12606-15175

September 30, 1973

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A title page for Volume 28, Numbers 1–6, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 27, No. 2, Abst. 4649, line 4 should read: 190p. (DOCKET-50362-28). Dep. NTIS.

NSA Vol. 27, No. 7, Abst. 16665, line 1 should read: (DOCKET-50219-229) OYSTER CREEK NUCLEAR

NSA Vol. 27, No. 8, Abst. 17975, line 3 should read: Ridge National Lab., Tenn.). (CAPE-2339).

Volume 28, Number 6, September 30, 1973

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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  Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
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35	**27-22017**	**Dep. NTIS, 98p.**

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 28, Number 6, September 30, 1973

Category	Page
CHEMISTRY	1195
Analytical and Separations Chemistry	1195
Activation and Nuclear Reaction Procedures	1195
Chemical and Spectral Procedures	1197
Radiometric and Radiochemical Procedures	1199
Separation Procedures	1200
Inorganic, Organic, and Physical Chemistry	1201
Chemical and Physicochemical Properties	1201
Isotope Effects	1202
Isotope Exchange and Isotope Separation	1203
Feed Materials Processing	1204
Radiation Chemistry	1204
Radiochemistry and Nuclear Chemistry	1206
Hot-Atom Chemistry	1207
Properties of Radioactive Materials	1207
Radioactive Waste Treatment	1208
Radioisotope Production	1209
Reactor Fuel Reprocessing	1210
ENGINEERING	1211
Energy Conversion	1211
Facilities and Equipment	1212
Heat Transfer and Fluid Flow	1212
Materials Testing	1213
Nuclear Explosions	1214
Protective Structures and Equipment	1216
Safety Engineering	1216
ENVIRONMENTAL AND EARTH SCIENCES	1217
Minerals and Ores	1217
Radioactive Effluents	1217
Radioactivity Monitoring and Transport	1217
Atmosphere	1217
Soil	1218
Water	1218
Ecosystems and Food Cycles	1218
Radiometric Techniques	1218
Site Surveys	1218
Thermal Effluents	1219
Chemical Effluents	1219
INSTRUMENTATION	1221
Radiation Detection Instruments	1221
General Detectors and Monitors	1221
Radiation Dosimeters	1222
Nuclear Spectroscopic Instrumentation	1224
High Energy Physics Instrumentation	1225
Radiometric Instruments	1226
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	1227
Miscellaneous Instruments	1227
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	1229
Isotope Separation (Industrial)	1229
Isotopic Power Sources	1229

Category	Page
ISOTOPE AND RADIATION SOURCE TECHNOLOGY (Cont'd.)	
Radiation Sources	1230
Design and Fabrication	1230
Industrial Uses	1230
LIFE SCIENCES	1232
Radiation Effects on Biochemicals	1232
Radiation Effects on Cells	1232
Radiation Effects on Microorganisms	1233
Radiation Effects on Plants	1236
Radiation Effects on Animals	1236
Man	1236
Vertebrates	1238
Invertebrates	1240
Radionuclide Effects (Internal Source)	1241
Man	1241
Animals	1241
Nuclide Kinetics and Toxicology	1241
Man	1241
Animals	1241
Microorganisms	1242
New Tracer Techniques	1242
MATERIALS	1244
Ceramics and Cermets	1244
Metals and Alloys	1248
Corrosion and Erosion	1249
Preparation and Fabrication	1252
Properties, Structure, and Phase Studies	1254
Radiation Effects	1262
Other Materials	1264
NUCLEAR MATERIALS AND WASTE MANAGEMENT	1271
Accountability and Safeguards	1271
Disposal and Storage	1271
Handling Equipment and Procedures	1271
Transportation	1273
PARTICLE ACCELERATORS	1274
Design, Development, and Operation	1274
Auxiliaries and Components	1274
Ion Sources and Injection and Extraction Systems	1274
Ion Optics and Field Calculations	1275
Experimental Facilities	1275
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	1276
Cosmic Radiation	1276
Stars	1277
Quasi-Stellar, Radio, and X-Ray Sources	1279
Solar Phenomena	1280
Galaxies	1281
Cosmology	1282
Planetary Phenomena	1282

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ATMOSPHERIC)	1284
Auroral and Ionospheric Phenomena	1284
Effects of Nuclear Detonations	1285
Magnetospheric Phenomena	1285
PHYSICS (ATOMIC AND MOLECULAR)	1288
Beams and Their Reactions	1288
Atomic and Molecular Properties	1288
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	1289
Collision Phenomena	1289
Atomic Theory	1290
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	1291
PHYSICS (HIGH-ENERGY)	1292
Particle Interactions and Properties (Experimental)	1292
Electromagnetic	1292
Weak	1292
Strong (Baryon-induced)	1292
Strong (Meson-induced)	1293
Particle Interactions and Properties (Theoretical)	1294
General	1294
Electromagnetic	1295
Weak	1298
Strong (General)	1299
Strong (Baryon No. = 0)	1301
Strong (Baryon No. = 1)	1302
Strong (Baryon No. ≥ 2)	1305
Particle Invariance Principles and Symmetries	1306
General	1306
Applications (Electromagnetic and Weak)	1307
Applications (Strong)	1308
Scattering Theory	1308
PHYSICS (LOW-TEMPERATURE)	1310
Superfluidity	1310
Superconductivity	1310
Equipment and Devices	1315
PHYSICS (NUCLEAR)	1326
Neutron Interactions with Matter	1326
Nuclear Properties and Reactions, $A \leq 5$	1327
Nuclear Properties and Reactions, $6 \leq A \leq 19$	1327
Nuclear Properties and Reactions, $20 \leq A \leq 38$	1329
Nuclear Properties and Reactions, $39 \leq A \leq 58$	1330
Nuclear Properties and Reactions, $59 \leq A \leq 89$	1332
Nuclear Properties and Reactions, $90 \leq A \leq 149$	1332
Nuclear Properties and Reactions, $150 \leq A \leq 189$	1334
Nuclear Properties and Reactions, $190 \leq A \leq 219$	1335
Nuclear Properties and Reactions, $A \geq 220$	1335
Nuclear Theory	1337
PHYSICS (PLASMA AND THERMONUCLEAR)	1342
Confinement and Heating	1342
Diagnostics	1342
Kinetics (General)	1343
Kinetics (Experimental)	1344
Kinetics (Theoretical)	1344
Production	1344
Stability	1345
Thermonuclear Engineering and Equipment	1346
Wave Phenomena	1347
PHYSICS (RADIATION AND SHIELDING)	1348
Radiation Physics	1348
Radiation Protection Standards	1349
Radiation Source Calibration and Standardization	1349
Shielding Calculations and Experiments	1349
PHYSICS (THEORETICAL)	1351
General	1351
Quantum Field Theories	1352
Gravitation and General Relativity	1353
REACTOR TECHNOLOGY AND REGULATION	1355
Power Reactors, Non-Breeding, BWR-Type	1355
Power Reactors, Non-Breeding, PWR-Type	1356
Power Reactors, Non-Breeding, Graphite Moderated	1358
Power Reactors, Non-Breeding, Otherwise Moderated	1361
Power Reactors, Breeding	1362
Research, Test, and Experimental Reactors	1367
Production and Materials Testing and Processing Reactors	1371
Propulsion and Package Reactors	1371
Reactor Safety and Environmental Aspects	1376
Reactor Theory and Calculation	1381
Reactor Components and Accessories	1385
Reactor Fuels	1396
Reactor Control Systems	1399
Nuclear Power Plant Economics	1400
Reactor Fuel Cycle Economics	1400
Reactor Licensing and Regulation	1400
GENERAL	1408
Energy Utilization and Economics	1408
Information Handling	1409
Management	1409
Mathematics and Computers	1410
Miscellaneous	1412
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-12
SUBJECT INDEX	INDEX-72
REPORT NUMBER INDEX	INDEX-173

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Volume 28, Number 6 September 30, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstract 14061.

12606 PROBLEMS OF NUCLEAR CHEMISTRY OR RADIOCHEMISTRY IN THE AREAS OF ENVIRONMENTAL RESEARCH AND TECHNOLOGY. Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta; 18: No. 3, 115-120(1972). (In German).

The fields of activity of environmental research and technology are explained and the importance of analytical chemistry is underlined. The problems connected with the operation of nuclear power plants and the utilization of radionuclides in medicine and other sectors of science and technology are considered. The application of radiochemical methods in the determination of trace elements is discussed and particular emphasis is laid on the unrivaled possibility of using labeled compounds in the study of transport processes related to questions of environmental research and environmental protection. (auth)

Activation and Nuclear Reaction Procedures

12607 (SUNI-23, pp 37-38) RAPID NEUTRON ACTIVATION ANALYSIS OF BROMINE IN BLOOD SERUM. Peisach, M.; Maziere, B.; Loc'h, C.; Comar, D.; Kellershohn, C. 1972.

12608 (SUNI-23, pp 41-43) ELEMENTAL AND ISOTOPIC DETERMINATION OF LITHIUM BY THE COINCIDENCE MEASUREMENT OF COMPLEMENTARY PARTICLES. Pretorius, R.; Coetzee, P. P.; Peisach, M. 1972.

12609 (SUNI-23, pp 43-44) DETERMINATION OF BERYLLIUM AND BORON BY COINCIDENT MEASUREMENT OF COMPLEMENTARY PARTICLES. Coetzee, P. P.; Pretorius, R.; Peisach, M. 1972.

12610 (SUNI-23, p 45) MEASURING MAGNESIUM PROFILES IN MAGNESIUM-ALUMINUM ALLOYS. Olivier, C.; Peisach, M. 1972.

12611 ENVIRONMENTAL SURVEILLANCE BY NEUTRON CAPTURE GAMMA RAYS. Wiggins, P. F. (Naval Academy, Annapolis, MD); Duffey, D.; Senftle, F. E. Trans. Amer. Nucl. Soc.; 16: 35-36(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12612 NEUTRON ACTIVATION ANALYSIS OF HUMAN HAIR: ESTABLISHING AN HISTORICAL BASELINE FOR THE HUMAN INTAKE OF TRACE METALS. Gordus, A. A.; Maher, C. C. III. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 16: 42(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12613 ADVANCES IN NUCLEAR ACTIVATION TECHNIQUES APPLIED TO ATMOSPHERIC PARTICULATES. Gordon, G. E.; Zoller, W. H. (Univ. of Maryland, College Park). Trans. Amer. Nucl. Soc.; 16: 42-43(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12614 ENVIRONMENTAL ANALYSIS AT ORNL'S HIGH-FLUX NEUTRON ACTIVATION LABORATORY. Ricci, E.; Handley, T. H.; Dyer, F. F. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 43-44(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12615 RAPID DETERMINATION OF BROMINE IN WATER SAMPLES BY ACTIVATION ANALYSIS. Abu-Samra, A.; Vogt, J. R. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 16: 44(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12616 CONTINUOUS ÀNALYZER BASED ON NEUTRON ACTIVATION ANALYSIS AND ^{252}Cf NEUTRON SOURCE; THEORETICAL DEVELOPMENTS. Janghorbani, M.; Ehmann, W. D.; Miller, M. D. (Univ. of Kentucky, Lexington). Trans. Amer. Nucl. Soc.; 16: 44-45(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12617 USE OF NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF TRACE AMOUNTS OF SILVER IN BIOLOGICAL SAMPLES. Bhattacharyya, S. K.; Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 62-63(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12618 ON-LINE ANALYSIS AND MONITORING OF WATER FOR GEOTHERMAL POWER BY NEUTRON CAPTURE GAMMA RAYS USING ^{252}Cf. Duffey, D. (Univ. of Maryland, College Park); Balagna, J. P.; Wiggins, P. F. Trans. Amer. Nucl. Soc.; 16: 63-64(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12619 APPLICATION OF THE FISSION TRACK REGISTRATION TECHNIQUE IN THE ESTIMATION OF THE FISSILE MATERIALS: ^{235}U-CONTENT IN NATURAL AND DEPLETED URANIUM SAMPLES IN SOLUTIONS. Iyer, R. H.; Sagu, M. L.; Sampathkumar, R.; Chaudhuri, N. K. (Bhabha Atomic Research Centre, Trombay, India). Nucl. Instrum. Methods; 109: No. 3, 453-459(1973).

The results of an investigation on the estimation of the ^{235}U content in natural and depleted uranium samples and total uranium in solutions including highly active fuel reprocessing waste streams using the solid state track registration technique are described. Two different methods were used: the "dry" method in which the detector (Lexan strip) was in contact with the fissile material in a 2 π geometry and the "wet" method in which the Lexan detector strips were kept immersed in the solution of the fissile material. The relative merits and demerits and also the accuracy and precision attainable by the two methods are discussed. The feasibility of using a portable neutron source for the estimation of the ^{235}U content was demonstrated and some of the practical problems encountered and the way in which they were overcome are discussed. (auth)

12620 CHARTS FOR SAMPLE AMOUNTS CORRESPONDING TO A SELF SHIELDING FACTOR 0.9 IN THERMAL NEUTRON ACTIVATION ANALYSIS. Okada, M. (Japan Atomic Energy Research Inst., Tokai). Anal. Chem.; 45: No. 8, 1578-1580(Jul 1973).

An aid is presented that provides calculated results for typical cases in the choice of sample size and for the estimation of a

self-shielding factor in thermal neutron activation analysis. (JGB)

12621 DETERMINATION OF FLUORINE IN BONE BY FAST NEUTRON ACTIVATION ANALYSIS. Mark, W. V. D.; Das, H. A. (Reactor Centrum Nederland, Petten). J. Radioanal. Chem.; 13: No. 1, 107-124(Jan 1973).

A routine method is presented for the determination of fluorine in small bone samples by activation analysis with fast conversion neutrons. Both the purely instrumental determination and the analysis by chemical separation are discussed. The activations are performed with the AVF cyclotron of Philips–Duphar at Petten. Use was made of a rabbit system equipped with a Be-target, which can be inserted in the internally deflected beam of the cyclotron. The sensitivity of the instrumental method is ≈1 μg. Application of chemical isolation results in a sensitivity of ≈0.1 μg. (auth)

12622 PURITY CONTROL OF ALUMINIUM METAL. Bishay, T. Z. (Scottish Research Reactor Centre, Glasgow). J. Radioanal. Chem.; 13: No. 1, 87-105(Jan 1973).

As a contribution to the neutron activation assay of the reactor grade aluminium, a number of elements were investigated by a developed analytical scheme. With the performance of ion-exchange chromatography combined with precipitation techniques, ppM concentration (or even less) of arsenic, antimony, calcium, copper, mercury, selenium, and strontium contaminants were demonstrated with good reproducibility. Whenever possible, some of the elements analyzed by radioactivation and proved to be present in high concentration levels were assayed by other standard analytical methods. (auth)

12623 NEUTRON ACTIVATION ANALYSIS OF URINARY STONES. Lawas, I. C. (Univ. of Philippines, Manila); Callar, A. D.; Feria, J. A. J. Radioanal. Chem.; 13: No. 1, 75-86(Jan 1973).

Human vesical, urethral and renal stones were analyzed for the trace elements Co, Cu, Mn, Zn, and Mo. Statistical correlations between the elements determined were sought which would be of possible interest in further research on the initial causes of urinary stone formation in the human body. (auth)

12624 DETERMINATION OF TRACE AMOUNTS OF SOME ELEMENTS IN ARMCO STEEL BY THE NEUTRON ACTIVATION METHOD. Jaskolska, H.; Rowinska, L.; Walis, L.; Tadwan, M. (Inst. of Nuclear Research, Swierk, Polant). J. Radioanal. Chem.; 13: No. 1, 41-52(Jan 1973).

The previously elaborated methods of the determination of As, Sc, La, Au, W, Mo, Ga, and In were adapted to the analysis of steel. Samples of Armco steel taken from three various points of a steel bar section were analyzed. On the basis of the results obtained the distribution of the elements determined along the steel bar section is discussed. (auth)

12625 DETERMINATION OF RARE EARTHS IN SILICATE ROCKS BY EPITHERMAL NEUTRON ACTIVATION AND A SIMPLE GROUP SEPARATION. Brunfelt, A. O. (Univ. of Oslo); Steinnes, E. J. Radioanal. Chem.; 13: No. 1, 11-20(Jan 1973).

The determination of nine rare earth elements in rock samples by epithermal neutron activation, followed by a simple group-separation procedure and Ge(Li) γ-ray spectrometry, is described. This method is found to be advantageous for the determination of Nd, Gd, Ho, Er, and Lu by means of the short-lived nuclides ^{149}Nd, ^{159}Gd, ^{166}Ho, ^{171}Er and ^{176m}Lu. Precision for La, Sm and Eu is similar to that of thermal neutron activation, that for Dy is worse. Samples of the standard rocks, basalt BCR-1 and granite G-2, were analyzed by this procedure and the results obtained are compared with previously reported data. (auth)

12626 GEOMETRY ERRORS IN 14 MeV NEUTRON ACTIVATION ANALYSIS. Van Grieken, R.; Speecke, A.; Hoste, J. (Ghent Univ.). J. Radioanal. Chem.; 13: No. 1, 225-233(Jan 1973).

The effects of inaccurate sample sizes and sample positioning on 14 MeV neutron activation analysis results are estimated for 30, 20 and 10 mm diameter targets. It appears that axial positioning is the most critical parameter and that using a larger tritium target will yield an overall improvement of the reproducibility. (auth)

12627 FAST NEUTRON ACTIVATION ANALYSIS: HIGH RESOLUTION GAMMA SPECTROSCOPY. Bennett, T.; Cavers, D.; D'Auria, J. M. (Simon Fraser Univ., Barnaby, British Columbia). J. Radioanal. Chem.; 13: No. 1, 201-212(Jan 1973).

A study is reported that was designed to demonstrate the versatility of combining the use of high resolution, Ge(Li) γ-detectors with the techniques of fast neutron activation analysis. A compilation of γ-ray spectra are presented for irradiation of 30 elements with 14.8 MeV neutrons under standard conditions and the origin of all major photopeaks is determined. (auth)

12628 ISOTOPIC DETERMINATION OF ^{48}Ca BY PHOTON ACTIVATION. Peisach, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 13: No. 1, 193-200(Jan 1973).

An activation analysis method was developed for the routine determination of ^{48}Ca. The calcium is chemically separated, converted to the hydroxide, carbonate or chloride, and activated for 30 min in the γ-ray flux generated by a primary electron beam between 40 and 57 MeV and a current of about 50 μA. A large number of samples can be activated simultaneously and the ratio of activities of ^{47}Ca and ^{43}K gives a measure of the isotopic concentration of ^{48}Ca. Naturally-occurring ^{44}Ca is used as an internal standard. The relative standard deviation is ±3.3%. (auth)

12629 MULTIPLICATION OF ERRORS DUE TO THE APPLICATION OF A RELATIVE MULTIPLE COMPARATOR METHOD. Linden, R. V. D.; Corte, F. D.; Hoste, J. (Ghent Univ.). J. Radioanal. Chem.; 13: No. 1, 169-179(Jan 1973).

The comparator method, earlier published by De Corte et al. is first discussed as well as a more practical transformation, which delivers directly the flux ratio, using a relative technique. For each part of the multiple comparator method (MCM) separately, a discussion of error multiplication is worked out and at the end a general formula to calculate the total error change is derived. (auth)

12630 STUDY OF THE CONTENT OF COPPER, ZINC, AND ARSENIC IN POWDERED MILK BY NEUTRON ACTIVATION. Lacroix, J. P.; Steinier, J.; Dreze, P. Anal. Lett.; 6: No. 6, 565-575(1973). (In French).

Copper, zinc, and arsenic were determined in dehydrated milk powder by neutron activation analysis. Irradiation of ashed milk powder in a flux of 10^{13} thermal neutrons/s/cm^2 was followed by elution through an anion exchange resin, solvent extraction of copper with dithizone into a chloroform phase, precipitation and subsequent redissolution of arsenic as As_2S_3 and as a polysulfide, respectively. The determinative step involved gamma spectroscopy of the isotopes ^{69m}Zn, ^{65}Zn, ^{64}Cu, and ^{76}As. (auth)

12631 DETERMINATION OF LOW BORON CONCENTRATIONS IN METALS. Zitnansky, B.; Jenis, V. (Welding Research Inst., Bratislava). Radiochem. Radioanal. Lett.; 14: No. 3, 175-181 (30 Jun 1973).

To determine low boron concentrations a combined absorption and activation method was elaborated enabling to determine thousandths of per cent and even less of boron in steel. As an intense neutron source neutron generator NA-3 was used, to which a polyethylene moderator was applied. Changes of radioactivity of indium foils as indicators of the absorption effect in dependence of the boron content in the specimen were measured. (auth)

12632 COMPARATIVE STUDY OF X-RAY AND γ-RAY SPECTROMETRY APPLIED TO NEUTRON ACTIVATION ANALYSIS OF HUMAN HEAD HAIR. Menke, H. (Univ., Mainz); Leszczynski, C.; Weber, M. Radiochem. Radioanal. Lett.; 14: No. 3, 217-226(30 Jun 1973).

X-ray and γ-ray spectra of ten different hair samples were measured after a short and a longer irradiation and different decay times, using high resolution Ge(Li)-detectors. For a number of elements such as Br, Cu, Ag, and Co, a more sensitive identification is possible from x-ray spectra rather than from γ-ray spectra. A combination of both x-ray and γ-ray spectrometry provides valuable additional information in the detection of trace elements in hair. (auth)

12633 DETERMINATION OF BERYLLIUM IN NOSE BLOW AND FAECAL SAMPLES USING A (γ,n) MONITOR. Eakins, J. D.; Lally, A. E. (Atomic Energy Research Establishment, Harwell, Eng.). Ann. Occup. Hyg.; 16: No. 1, 33-39(Apr 1973).

Methods are described for the determination of beryllium in nose blow samples and in faeces. Nose blow samples taken on paper tissues are ashed after the addition of ferric nitrate solution to increase the bulk. The ash is transferred to a sample tube and the beryllium determined in a (γ,n) beryllium monitor. Faecal samples are ashed and the ash is pelleted in a small hand press. The beryllium content of the pellet is determined by (γ,n) counting. The sensitivity of this procedure is 0.7 μg Be for nose blow samples and 1 μg Be/g for faecal ash. The derivation of an investigation level for beryllium in nose blow samples is discussed and it is concluded that a value of 5 μg should be adopted for routine operational use. Should this level be exceeded a programme of faecal sampling should be initiated to enable a more accurate estimate of the lung burden to be made. (auth)

12634 ACTIVATION ANALYSIS DETERMINATION OF TRACE ELEMENTS IN LEAD THROUGH COMPUTER EVALUATION OF THE Ge(Li) GAMMA SPECTRA. Schubiger, A.; Wyttenbach, A. (Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Helv. Chim. Acta; 56: No. 2, 648-654(1973). (In German).

Samples of lead (10 to 250 mg) were taken from ancient Roman objects and milled into pellets of 0.3 mm thickness, which were activated for 5 hours in the reactor Saphir at a thermal neutron flux of 10^{13} n/cm^2. The gamma spectra were measured with a Ge(Li) detector and a 4000-channel analyzer. For evaluation of the spectra, a computer program (Jeanne) was developed. Results were good and reproducible. The procedure was so general and so fast as to be applicable to many other problems. (HBG)

12635 DETERMINATION OF MERCURY IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Behne, D. (Hahn Meitner-Institut fuer Kernforschung, Berlin). Radiochim. Acta; 18: No. 3, 153-156(1972). (In German).

A simple one-step separation method for the activation analysis of mercury in biological material was developed. After destruction of the irradiated sample with a $H_3PO_4-H_2O_2$ mixture the metal is distilled from an acetic acid solution. The recovery values are higher than 99%. For the gamma spectrometry ^{197}Hg can be used, or ^{203}Hg as the interfering ^{75}Se is separated. The method was tested in model experiments and in the determination of mercury in a biological standard material. (auth)

12636 COMPARISON OF VARIOUS ACTIVATION ANALYSIS METHODS FOR TRACE ANALYSES FOR OXYGEN. Reimers, P. (Bundesanstalt fuer Materialpruefung, Berlin); Mayolet, F.; Engelmann, C. Radiochim. Acta; 18: No. 3, 150-153(1972). (In German).

Three nuclear reactions are discussed which lend themselves particularly well to oxygen assays by means of activation analysis. The limits of detection are set by the capacity of the radiation sources presently available. They are 10 ppM for the ^{16}O(n,p) ^{16}N-reaction. 1 ppM for the ^{16}O(γ,n) ^{15}O-reaction, and 5 ppB for the ^{16}O (^{3}He,p) ^{18}F-reaction. (auth)

12637 SEPARATION OF Na, K, AND P BY MEANS OF INORGANIC SEPARATORS IN THE NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL MATERIAL. Toeroek, G.; Schelenz, R.; Fischer, E.; Diehl, J. F. (Institut fuer Strahlentechnologie, Karlsruhe, Ger.). Z. Anal. Chem.; 263: No. 2, 110-115(1973). (In German).

Two sorption processes for the removal of the matrix activity of neutron-activated biological samples were investigated in detail. Hydrated antimony pentoxide (HAP), prepared by various methods, was applied to remove the ^{24}Na, while zirconium phosphate (ZP) was used for the removal of ^{32}P. Commercially available (S.E.R.A.I.) titanium phosphate (TiP) was applied for the retention of ^{42}K. The optimal conditions for preparation and application of these substances were determined by investigation of the sorption parameters and of some physico-chemical properties. Applying the sorption materials HAP, ZP, and TiP under the chosen working conditions, none of the three disturbing activities could be detected in neutron-irradiated potato samples. A semiautomatic apparatus was constructed for the dissolution and chemical processing of the irradiated materials, the main parts of which are the following: distillation apparatus, sorption column, ion-exchange column, gradient-elution system, electropneumatical valves, and a fraction collector. The entire chemical processing is carried out by remote control, the time requirement being about 7 h. (auth)

12638 SIMULTANEOUS DETERMINATION OF Mn, Cu, As, Ca, Sb, AND Hg IN GLACIAL ICE BY RADIOACTIVATION. Weiss, H. V. (Naval Undersea Center, San Diego, CA); Bertine, K. K. Anal. Chim. Acta; 65: No. 2, 253-259(Jul 1973).

A method was developed to measure simultaneously the concentration of the elements manganese, copper, arsenic, cadmium, antimony, and mercury in glacial ice. Samples and comparators were irradiated for 60 min in a thermal flux of 1.8×10^{12} n cm^{-2} s^{-1}. The six elements were separated from the irradiated samples sequentially; mercury, arsenic, and cadmium received additional radiochemical purification. The γ-rays of the ^{56}Mn, ^{64}Cu, ^{76}As, ^{122}Sb, and ^{197}Hg and the β-rays of the ^{115}Cd–^{115}In were measured. All the elements were detectable at the subnanogram level. Comparison of the detection limits with the concentration of elements in the samples indicated that, even with the moderate neutron flux available and for ice from a relatively uncontaminated environment, the methods used were sensitive enough for adequate characterization. (auth)

12639 NEUTRON ACTIVATION PROCEDURE FOR THE DETERMINATION OF DISSOLVED SILVER IN SEA WATER. Kawabuchi, K.; Riley, J. P. (Univ. of Liverpool). Anal. Chim. Acta; 65: No. 2, 271-277(Jul 1973).

A neutron activation procedure was developed for the determination of silver in sea water. The element is preconcentrated by an anion-exchange procedure. The concentrate is submitted to irradiation with thermal neutrons. Silver-110m is separated from other radionuclides by means of a conventional radiochemical separation scheme. The method gave a coefficient of variation of ±10% at a silver level of 40 ng l^{-1}. (auth)

12640 DETERMINATION OF BROMIDES IN BLOOD BY NEUTRON ACTIVATION ANALYSIS. Atallah, M. M.; Geddes, I. C. (Univ. of Liverpool). Brit. J. Anaesth.; 45: No. 2, 134-138(Feb 1973).

A method is described for the determination of bromides in biological samples using neutron activation analysis. The specificity of this method eliminates sources of interference from other halogens and contamination of analytical agents with extraneous bromide. In duplicate samples of blood, at varying concentrations of potassium bromide, the mean difference was 4.5% ± 1.95 and the mean of the SD of twelve duplicate estimations was ±0.87. The 95% confidence limit of a single estimation was ±1.6%. (auth)

12641 DETECTION OF FLUORINE THROUGH THE ^{19}F(p,$\alpha\gamma$)-^{16}O REACTION. Anttila, A.; Keinonen, J. (Univ. of Helsinki). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 293-294(May 1973).

To overcome the sample preparation difficulties encountered when elemental analysis is carried out by the characteristic x-ray excitation method or by the nuclear back-scattering method, proton–gamma reaction methods were investigated. In order to test the sensitivity of these methods the reaction ^{19}F(p,$\alpha\gamma$)^{16}O was used with a strong resonance at E_p = 873 keV. Carbon, copper, tantalum, gold, and glass plates were investigated. The sensitivity of the method was found to be good, the sample preparation easy and a great advantage is that, by using thick samples, one can measure the amounts of fluorine both on the sample surface and below it, inside the sample. It is often important to know whether fluorine or any other element occurs only as a surface impurity or as a real part of the material. By measuring at the resonance energy, the surface fluorine atoms produce the gamma ray yield, while with a bombarding energy increased by a few keV, only those fluorine atoms which are in the material below the surface, produce the gamma ray yield. However a disadvantage of this method is that, although it is possible to reach good statistical accuracy, the estimation of the stopping power values for the samples containing unknown elements causes an uncertainty in the determination of fluorine. (UK)

12642 MINERAL EXPLORATION OF THE OCEAN FLOOR BY NEUTRON CAPTURE GAMMA RAYS. Wiggins, P. F. (U. S. Naval Academy, Annapolis, MD); Duffey, D.; Senftle, F. E. Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 22-23(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Chemical and Spectral Procedures

Refer also to abstract 12774.

12643 (HW–53455) FLUORIMETRIC URANIUM ANALYSIS WITH A HIGH CARBONATE FLUX. Campbell, M. H. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 1 Nov 1957. Contract W-31-109-Eng-52. 16p. Dep. NTIS $3.00.

It was demonstrated that the high carbonate flux has several advantages over the conventional sodium fluoride flux for use in the fluorimetric determination of uranium. Among these advantages are simplified melt preparation, more uniform melts, elimination of extraction as a method for isolating the uranium from nitric acid, a less time consuming procedure, and a simpler, more effective dish-cleaning technique. A more exact method was developed for calibrating the fluorimeter. (auth)

12644 MEASUREMENT OF CARBON ACTIVITY IN SODIUM SYSTEMS. Natesan, K.; Kassner, T. F. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 112(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12645 DETERMINATION OF METALS IN MIXED HYDROCHLORIC AND PERCHLORIC ACIDS BY FORCED-FLOW ANION EXCHANGE CHROMATOGRAPHY. Seymour, M. D.; Fritz, J. S. (Ames Lab., IA). Anal. Chem.; No. 8, 1394-1399(Jul 1973).

Anion exchange behavior of ten metal ions, including Ru(IV), was studied in mixtures of hydrochloric and perchloric acids. Several metal ions can be eluted with this mixture that are almost impossible to elute with hydrochloric acid alone. Using hydrochloric–perchloric acid mixtures, several separations are demonstrated with forced-flow chromatography and automatic uv detection of the eluted elements. The separations are rapid and quantitative. (auth)

12646 GAS CHROMATOGRAPHIC DETERMINATION OF AQUEOUS HALIDES. Matthews, D. R. (Oak Ridge National Lab., TN); Shults, W. D.; Dean, J. A. Anal. Lett.; 6: No. 6, 513-522(1973).

Bromide, iodide, and chloride were extracted from aqueous solutions into toluene–alcohol solutions of tetraheptylammonium carbonate. The tetraheptylammonium halides undergo thermal degradation of 1-haloheptanes and triheptylamine. On-column preparation of the haloheptanes was achieved above 150°C. The halocarbons produce gas chromatographic peaks which are used for quantitative analysis of bromide, chloride, and iodide at low ppM levels. (auth)

12647 TARGET BACKINGS FOR CHARGED PARTICLE INDUCED X-RAY FLUORESCENCE ANALYSIS. Herman, A. W.; McNelles, L. A.; Campbell, J. L. (Univ. of Guelph, Ont.). Nucl. Instrum. Methods; 109: No. 3, 429-437(1973).

The trace element content of target foils fabricated from spectroscopic carbon and graphite supplied by various manufacturers has been measured using proton-excited x-ray fluorescence analysis. The relative importance of impurities in the bulk material and impurities introduced during fabrication of the foils was studied. The objective was to select the most suitable target backing for use in the analysis of biomedical specimens by this technique. (auth)

12648 DETERMINATION OF SOME RARE-EARTH ELEMENTS BY PLASMA JET EMISSION SPECTROMETRY. Atsuya, I.; Goto, H. (Kitami Inst. of Tech., Japan). Anal. Chim. Acta; 65: No. 2, 303-309(Jul 1973).

The effects of a magnetic field on spectral intensities in plasma-jet spectrometry were examined, and detection limits for rare earth elements were calculated. Plasma-jet emission spectrometry was applied to the determination of lanthanum, yttrium, and gadolinium in a monazite sample from which thorium had been separated. A standard addition method was used in order to improve accuracy, and the internal standard and background compensation method was applied to measurements of spectral line intensities to achieve good precision. The coefficient of variation was 1.51% for 50 μg La ml^{-1}. (auth)

12649 BIS-AROYLHDRAZONES OF α-DIKETONES AS REAGENTS FOR COLORIMETRIC AND FLUORIMETRIC DETERMINATIONS OF CALCIUM, CADMIUM, AND OTHER CATIONS. Lever, M. (Greenlane Hospital, Auckland, New Zealand). Anal. Chim. Acta; 65: No. 2, 311-318(Jul 1973)

The bis(4-hydroxybenzoylhydrazones) of glyoxal, methylglyoxal and dimethylglyoxal form colored chelates with Ca^{2+}, Cd^{2+}, La^{3+}, a Bi(III) species and other cations. The glyoxal derivative shows more selective reactions, and highly selective assays are possible for calcium and cadmium in the presence of cyanide and citrate, respectively; Beer's law was obeyed in the range 0 to 50 mM for both cations. The chelates were also fluorescent, the reaction for lanthanum being particularly sensitive. The formation of this type of chelate is a general property of the bis-aroylhydrazones of α-diketones. (auth)

12650 EXTRACTION-PHOTOMETRIC DETERMINATION OF URANIUM(IV) WITH CHLOROPHOSPHONAZO-III. Yamamoto, T. (Japan Atomic Energy Research Inst., Tokai). Anal. Chim. Acta; 65: No. 2, 329-334(Jul 1973).

A sensitive spectrophotometric method was developed for the determination of uranium. The uranium(IV)–chlorophosphonazo-III complex is extracted into 3-methyl-1-butanol from 1.5 to 3.0 M hydrochloric acid solution. Maximal absorbance occurs at 673 nm and Beer's law is obeyed over the range of 0 to 15 μg per 10 ml of the organic phase. The molar absorptivity is 12.1×10^4 l $mole^{-1}$ cm^{-1}. Uranium can be determined in the presence of fluoride, sulfate and phosphate. Nitrate ion and elements (chromium, copper, iron) which affect the reduction of uranium(VI) or stability of uranium(IV) interfere. (auth)

12651 DETERMINATION OF NEODYMIUM IN NEODYMIUM-DOPED YTTRIUM–ALUMINUM GARNET CRYSTALS BY MEANS OF ATOMIC ABSORPTION SPECTRAL ANALYSIS. Koenig, K. H.; Neumann, P. (Johann Wolfgang-Goethe Univ., Frankfurt am Main). Anal. Chim. Acta; 65: No. 1, 210-212(Jun 1973). (In German).

The neodymium concentration was determined as follows: 250 mg of the neodymium-doped yttrium–aluminum garnet crystals were powdered and dried. After addition of 1 g lithium carbonate and 1 g lithium tetraborate, the powder was melted for 4 hours at 1000°C. Subsequently, the solidified material was dissolved in 60 ml of 1 N sulfuric acid, and water was added. Samples were measured with a spectrometer and an acetylene–N_2O flame with excess fuel gas. The sensitivity ranged from 22 to 32 μg Nd per milliliter. (HBG)

12652 DETERMINATION OF URANIUM AND CERIUM IN MIXED OXIDE FUELS. Spevackova, V.; Krumlova, L. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 14: No. 3, 193-198(30 Jun 1973).

A simple redox method is described for the determination of uranium and cerium in mixed oxides fuels. The potentiometric indication of the equivalence point increases the accuracy of the determination of the mentioned elements up to 0.3%. (auth)

12653 DETERMINATION OF ERBIUM AS ITS ARSENATE. Shakhtakhtinskaya, I. G.; Iskenderov, M. G. Azerb. Khim. Zh.; No. 4, 117-120(1972). (In Russian).

A method for determining Er quantitatively was developed based on the formation of an insoluble yellow-red precipitate with arsenate ions at a pH of about 2. The precipitate was redissolved in H_2SO_4, mixed with KI solution, and the liberated I_2 was titrated with standard $Na_2S_2O_7$. Adequate accuracy was obtained with a concentration of Er in the original sample of 0.1 mg Er/100 ml of solution. (KSW)

12654 SPECTROPHOTOMETRIC INVESTIGATION OF SOME ORGANIC REAGENTS FOR DETERMINING RARE EARTH ELEMENTS OF THE CERIUM SUBGROUP. Akhmedli, M. K.; Ayubova, A. M.; Babaeva, T. R. Azerb. Khim. Zh.; No. 4, 121-125 (1972). (In Russian).

The reactions of rare earth ions of the Ce subgroup with pyrocatechol violet, pyrogallol red, methylthymol blue, alizarin red S, and hematoxylin were investigated photometrically. Optimum conditions of complex formation were found from absorption spectra of these reagents and of their complexes with Eu and Gd at various pH values. It was established that pyrocatechol violet, methylthymol blue, pyrogallol red, and hematoxylin were suitable reagents for rare earths of the Ce subgroup. (KSW)

12655 GLASS AS A SUBSTRATE FOR SEPARATION OF GOLD(III), SELENIUM(IV), AND TELLURIUM(IV) BY THIN-LAYER CHROMATOGRAPHY. Gaibakyan, D. S.; Egikyan, R. T. (Erevan State Univ.). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 12, 2757-2760(Dec 1972).

Translated from Zh. Prikl. Khim.; 45: No. 12, 2623-2627(Dec 1972).

A study is reported on the use of glass powders as substrate for separating gold(III), selenium(IV), and tellurium(IV) ions. The R_f values of selenium(IV), tellurium(IV), and gold(III) ions in solutions of mineral acids at concentrations over 1 N are 0.95, regardless of the nature of the acid, because they are not sorbed by the glass. Glass powder may serve both as a sorbent and as an inert substrate for these ions in thin-layer chromatography. Identification and quantitative separation of the ions can be effected with the aid of 0.1 to 0.5 N solutions of hydrobromic acid at 0.5:99.5 ratio of AV-17 anion-exchange resin in the Cl form to glass powder. (auth)

12656 MICROCHEMICAL ANALYSIS OF Cd–Ga–Te AND Cd–In–Te SYSTEMS. Vesene, T. B.; Raichinskite, B. K. (Inst. of Physics of Semiconductors, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 6: No. 73, 115-118(1972). (In Russian).

The determination of Cd in Cd–Ga–Te and Cd–In–Te systems is based on fluorescence of the Cd complex with 8-[(p-tolylsulfonyl) amino]quinoline. In and Ga are determined by photometry as a complex with xylenol orange. Te is determined by photometry as a sol of elemental Te. The relative error of determination is ±2%. (auth)

12657 SELENIUM ISOTOPE ANALYSIS AND GEOCHEMICAL APPLICATIONS. Webster, C. L. Fort Collins, CO; Colorado State Univ. (1972). 82p. University Microfilms Order No. 73-13,053.

Thesis (Ph. D.).

The $^{74}Se/^{80}Se$ ratios of laboratory and natural selenium samples were determined by an A.E.I. MS-20 isotope mass spectrometer. The selenium was analyzed as selenium hexafluoride that was prepared by fluorinating elemental selenium with cobalt(III) fluoride. Precision for any given run was ±1.01 p.p.t. providing the operating standards were met. A harmonic rate ratio (HRR) of 1.010 was obtained for the reduction of selenite by hydroxylamine. Using atom fragments and assuming the activated complex is identical to the stable selenite Rees and Thode's theoretical HRR value is 1.011. An investigation of the ^{74}Se content of selenium associated with a uranium roll-type deposit, in Shirley Basin, Wyoming, revealed a $\delta^{74}Se$ variation of 100 p.p.t. over an 18 inch interval. (Diss. Abstr. Int., B)

12658 SEPARATION AND QUANTITATIVE DETERMINATION OF THE CERIUM GROUP LANTHANIDES BY GAS–LIQUID CHROMATOGRAPHY. Burgett, C. A.; Fritz, J. S. (Ames Lab., IA). Talanta; 20: No. 4, 363-369(Apr 1973).

A gas chromatographic method is reported for the separation and subsequent quantitative determination of the cerium group

lanthanides (La, Ce, Nd, Sm, Eu, Pr). The lanthanides (RE) are synergistically extracted from aqueous solutions with the polyfluorinated β-diketone 1,1,1,2,2,6,6,7,7,7-decafluoro-3,5-heptanedione, H(FHD), as ligand, and di-n-butylsulphoxide, DBSO, as neutral donor. The composition of the extracted species is reported to be $RE(FHD)_3 \cdot 2DBSO$. Thermogravimetric analysis of the complexes is reported. Analytical curves were prepared and found to be usable over the range of 0.1 to 10 μg of metal. Individual lanthanides were determined with 99.0% recovery with a relative mean deviation of ±2.0%. Mixtures of lanthanides were analyzed with 101.2% recovery with a relative mean deviation of ±2.2%. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 12859, 12890, 12929, 12930, 12941, 12968, 13090, 13100, and 13186.

12659 (K-Trans-65) PROCESS FOR THE DETERMINATION OF THE DEGREE OF ENRICHMENT OF URANIUM-235 FROM THE α ACTIVITIES OF URANIUM ISOTOPES. Bernhard, F.; Blumentritt, G.; Schintlmeister, J. Translated from Atompraxis; 6: 154-158(1960). 10p. Dep. NTIS $3.00.

If ^{235}U is enriched by means of diffusion, the ratio between the isotopes ^{234}U and ^{238}U is altered. Measurement of the intensity of the α rays of these isotopes indicates the degree to which ^{235}U has been enriched. The procedure is especially sensitive to slight enrichment. Measurements were carried out easily using a proportional counter that counts the α rays emitted from a very thin layer of uranium surrounding the counter at a distance of 14 cm. Because of this considerable distance, the surface of the preparation is 1900 cm^2. The rays are collimated. The range distribution of the α rays from the preparation is registered by changing the air pressure in the measurement chamber. The tension of the counter is adjusted according to the pressure. (auth)

12660 (SUNI-23, pp 39-40) ANALYSIS OF GLASS BY SIMULTANEOUS SPECTROMETRY OF SCATTERED ALPHA PARTICLES AND PROMPT PROTONS. Peisach, M.; Pretorius, R. 1972.

12661 (SUNI-23, pp 40-41) ELASTIC SCATTERING OF IONS FROM THICK TARGETS. Peisach, M. 1972.

12662 COMPARISON OF SOURCE-SAMPLE FISSION COINCIDENCE METHOD WITH THE RANDOM DRIVER METHOD. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 16: 62(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12663 FISSIONABLE MATERIAL ASSAY USING MUONIC X RAYS. Malanify, J. J.; Auguston, R. H.; Close, D. A.; East, L. V.; Umbarger, C. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 66(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12664 RADIOACTIVITY ASSAY USING GAMMA-RAY SPECTROMETRY. Heath, R. L. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 16: 67(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12665 SILICON SURFACE STUDIES BY MEANS OF PROTON BACKSCATTERING AND PROTON INDUCED X-RAY EMISSION. Van der Weg, W. F. (Philips Gloeilampenfabrieken, Amsterdam); Kool, W. H.; Roosendaal, H. E.; Saris, F. W. Radiat. Eff.; 17: No. 3-4, 245-252(1973).

The contamination of silicon surfaces treated with different etching solutions is studied by proton backscattering and proton-excited characteristic x-ray emission, using primary energies of 100 to 140 keV. Carbon, oxygen, and iodine atoms were observed on the surface. A suitable etching treatment reduced the oxygen coverage to a value of 0.2 monolayer. Furthermore, by using the channeling effect, a correlation between the number of displaced silicon atoms at the surface and the oxygen coverage is demonstrated. Measurements of carbon-K emission cross sections are reported, which enable one to use the characteristic x-ray emission as a quantitative analytical tool. (auth)

12666 INVESTIGATION AND RADIOMETRIC DETERMINATION OF SATURATED AND UNSATURATED ALIPHATIC MONOCARBOXYLIC ACIDS AND AROMATIC DICARBOXYLIC ACIDS. Oemboely, Cs.; Szarvas, T.; Vegh, G. (Inst. for Isotopes, Budapest). J. Radioanal. Chem.; 13: No. 1, 67-74(Jan 1973).

Investigations were carried out on the precipitation of calcium salts of saturated and unsaturated aliphatic monocarboxylic acids and of aromatic dicarboxylic acids. The optimum ethanol/water solvent ratio was studied at which the sodium, ammonium, or triethylammonium salts of the acids have a good solubility, whereas the calcium salts are poorly soluble and can be precipitated. Based on these investigations the radiometric determination of formic acid, palmitic acid, stearic acid, methacrylic acid, oleic acid, and o-, m- and p-phthalic acids is possible. A linear correlation was found between the solubilities of the calcium salts of o-, m- and p-phthalic acids and the dielectric constant of the solvent mixture. $CaCl_2$ solution labelled with $^{45}CaCl_2$ was used for the titrations, with a solvent composition identical to that of the solution to be titrated. Radiometric titrations were carried out in 0.05 M solutions for dicarboxylic acids, and in 0.1 M solutions for monocarboxylic acids. For palmitic and stearic acids titrations were also carried out in the 0.01 M concentration range. The equipment used for titrations was capable of detecting isotopes of soft β-radiation. (auth)

12667 RADIOMETRIC TITRATION BASED ON COLLOIDAL AND SLOW PRECIPITATE FORMATION. Oembloely, Cs.; Szarvas, T.; Vegh, G. (Inst. for Isotopes, Budapest). J. Radioanal. Chem.; 13: No. 1, 59-65(Jan 1973).

Fluoride ions and, in about 0.005 M concentration, tungstate ions form gelatinous precipitates, poorly soluble in water, with calcium ions. The radiometric determinations of the above ions are based on these reactions. Accurate radiometric determination can be carried out only if the gelatinous precipitate formed during titration can be properly separated from the solution. It was found that in the case of fluoride ions the application of crystalline, easily filtrable $Ca(COO)_2 \cdot H_2O$ or $CaCO_3$, and in the case of tungstate ions the application of $CaWO_4$ precipitate improves the filtration properties of $^{45}CaF_2$ and $^{45}CaWO_4$, respectively, formed during titration, whereby the radiometric determinations of the above ions become possible. Titrations were carried out with 0.05 M and 0.005 M $CaCl_2$ solutions, labelled with ^{45}Ca. (auth)

12668 EVALUATION OF TRAPPING COMPOUNDS USED FOR DETERMINING $^{14}CO_2$ BY LIQUID SCINTILLATION COUNTING. Stewart, A.; Weir, N. A. (Lakehead Univ., Thunder Bay, Ont.). J. Radioanal. Chem.; 13: No. 1, 31-36(Jan 1973).

Four commonly used trapping agents for scintillation counting of $^{14}CO_2$ (Hyamine, Primene, ethanolamine and β-phenylethylamine) were assessed under identical conditions, the progress of trapping being measured directly by pressure changes and by liquid scintillation counting. It was found that quantitative absorption required considerably longer periods of time than those previously reported and that absorption at low $^{14}CO_2$ pressures was very slow. The effects of pressure and stirring rate were also studied. (auth)

12669 CORRECTION FOR CHANGE IN ACTIVITY DURING COUNTING. Moore, H. (LFE Corp., Richmond, CA). J. Radioanal. Chem.; 13: No. 1, 165-168(Jan 1973).

An analytical expression for the general change-in-activity-during-counting correction factor is derived, and several special cases are pointed out. (auth)

12670 AUTOMATIC GAS-CHROMATOGRAPHIC ANALYSER FOR THE DETERMINATION OF THE RADIOACTIVITY OF ARGON, KRYPTON AND XENON. Vespalec, R.; Pietrik, I.; Moravek, J. (Power Research Inst., Brastislava). J. Radioanal. Chem.; 13: No. 1, 155-164(Jan 1973).

An instrumental procedure for the determination of the amount and the radioactivity of argon, krypton, and xenon was worked out and an automatic analyser was designed. A sample was taken from the residual gases remaining after absorption in a solution of potassium hydroxide. Oxygen was catalytically combusted and carbon monoxide converted to methane in a stream of hydrogen. Argon and krypton were separated on a 5.5 m long column packed with Porapak Q, and xenon was analyzed on a 0.4 m long column of Synachrom G-5 at 0°. The radioactivity of the pure components was measured with a flow-type proportional counter. The system proposed and the analyser can be simply adapted to run off determinations of other admixtures in the coolants of nuclear power plants. (auth)

12671 ISOTOPIC DILUTION DETERMINATION OF LEBAYCID IN ORANGES. Angoso, M.; Jimeno, F.; Grau, A.; Dominguez, G. (Junta de Energia Nuclear, Madrid). J. Radioanal. Chem.; 13: No. 1, 149-154(Jan 1973).

Isotopic dilution is shown to be a suitable method for the analysis of traces of Lebaycid in oranges with appropriate sensitivity, accuracy and precision. The procedure involves solubilization of Lebaycid in acetonitrile followed by purification: extraction with hexane from a mixture of methanol and water, chromatography in an alumina column and TLC on silica gel. Factors governing precision are discussed. (auth)

12672 ASSAY OF ^{89}Sr IN PLANT AND SOIL SAMPLES BY LIQUID SCINTILLATION COUNTING. Hardcastle, J. E.; Fuller, W. H.; Hannapel, R. J. (Univ. of Arizona, Tucson). J. Radioanal. Chem.; 13: No. 1, 141-147(Jan 1973).

The Sr in plant and soil samples is converted to $SrCl_2$ by digestion with HNO_3 and HCl. The recovery of this digestion is 90% with a reproducibility of about 4%. $SrCl_2$ is solubilized in toluene by forming a complex with di-n-propyl phosphate (DNP). The DNP-toluene reagent was found to be a highly effective carrier of $SrCl_2$, and to have properties suitable for highly efficient liquid scintillation counting. An efficiency of 95% was obtained for ^{89}Sr counting. The factors affecting the utility of the method are discussed. (auth)

12673 RAPID DETERMINATION OF LOW CONCENTRATION OF LONG LIVED ALPHA-EMITTERS IN THE ATMOSPHERE BY ALPHA SPECTROMETRY. Winkle, R.; Hoetzi, H. (Gesellschaft fuer Strahlen- und Umweltforschungj, Nuremberg). J. Radioanal. Chem.; 13: No. 1, 235-246(Jan 1973).

A sensitivity of 0.04 to 0.01 pCi/m^3 for long-lived α-emitters in air is obtained by α-spectrometry of electrostatically precipitated aerosols in a large Frisch grid ionization chamber after decay of the natural activity for 2 or 4 hrs and 100 min counting. This corresponds to about 0.1 to 0.01 of the maximum permissible concentrations (168 hrs/week) for ^{239}Pu and other toxic long-lived α-emitters. The dependence of the sensitivity of the procedure on variable background contributions by Rn and Tn daughter products was investigated. After ^{212}Bi (ThC) has significantly decayed, the sensitivity is 0.0002 to 0.001 pCi/m^3 in the 5 MeV region with 1,000 min counting. Direct determination of the natural ^{210}Po (RaF) content in the atmosphere or the determination of other α-emitters at that activity level is thus possible without sample preparation or chemical treatment. An example for the low-level detection of transuranium nuclides in the air of a hot laboratory is presented. (auth)

12674 ANALYSIS OF LIGHT ELEMENT COMPOUNDS BY MEANS OF PROTON ELASTIC SCATTERING. Habanec, J. (Inst. of Nuclear Physics, Rez, Czechoslovakia; Zarobsky, M.; Petrina, A.; Janousek, Z. J. Radioanal. Chem.; 13: No. 1, 213-223(Jan 1973).

A nondestructive method sensitive above all to atoms of light elements is proposed for the analysis of compounds. Preliminary results to the analysis of organic substances and boron compounds are presented. The target was cooled to the temperature of liquid nitrogen. A proton beam with an energy of 3.2 MeV was obtained with a Van de Graaff accelerator. (auth)

12675 INFLUENCE OF THE STATISTICAL ERROR IN RADIOACTIVITY COUNTING ON THE PRECISION OF ISOTOPE DILUTION ANALYSIS. III. Kyrs, M.; Kandiyotti, R. (Inst. of Nuclear Research, Rez, Czechoslovakia). J. Radioanal. Chem.; 13: No. 1, 181-192(Jan 1973).

A slightly modified procedure of direct substoichiometric isotope dilution analysis is theoretically treated and its advantages are stated. The precision of one case of reverse isotope dilution is calculated, and tables for rapid calculation of optimum measuring conditions and of the resulting errors are given. The precision and optimum conditions are calculated for determining the count rate ratios of two radioisotopes present in a mixture using two instruments (absorbers), and pertinent tables are presented. (auth)

12676 ESTIMATION OF LOW-ENERGY β-NUCLIDES USING SILICON DETECTORS WITH PARTIALLY DEPLETED SURFACE BARRIER. II. Simultaneous Estimation of Two β-Nuclides. Tykva, R.; Panek, V. (Inst. of Organic Chemistry and Biochemistry, Prague). Radiochem. Radioanal. Lett.; 14: No. 2, 109-121(15 Jun 1973).

An analysis is presented of working conditions attainable with the use of partially depleted surface-barrier silicon detectors in estimations of the pairs $^{14}C + ^{32}P$ or $^{14}C + ^{35}S$. Optimum conditions were found for a simultaneous nondestructive assay of the radionuclides in the pairs mentioned by means of the amplitude as well as for the estimation of ^{32}P alone. The maximum attainable detection sensitivity was determined. The obtained parameters were verified by the simultaneous estimation of $^{14}C + ^{32}P$ in adenosine 5'-triphosphate both in evaporation residues and on paper chromatograms. (auth)

12677 RADIOCHEMICAL DETERMINATION OF GROSS ALPHA ACTIVITY IN URINE BY ADSORPTION ON DEXTRAN GEL SEPHADEX. Hafez, M. B.; Saied, F. I. (Atomic Energy Establishment, Inshas, Egypt). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 241-244(May 1973).

This work demonstrates that the phenomenon of surface adsorption of some fission products and alpha elements on "Sephadex" could be used to advantage as part of routine analytical procedure for the determination of gross alpha and beta activities in urine. The method consists of coprecipitation of the radionuclides on calcium phosphate from urine, adsorption of ions from the phosphate solution at pH 5.0 on Sephadex, then elution of the adsorbed activity with 30 ml 0.5 N HCl, and finally preparing a source for α and β counting. The recoveries of this method were about 85 ± 3.7%. (auth)

12678 LIQUID SCINTILLATION COUNTING OF HIGH ENERGY β-RAYS ON CHROMATOGRAM AND PHEROGRAM STRIPS. Blasius, E.; Spannhake, N. (Univ. des Saarlandes, Saarbruecken, Ger.). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 301-303(May 1973). (In German).

Experiments are described in which the method of direct counting of chromatogram and pherogram strips by liquid scintillation, successful with soft β-emitters, was tried on ^{32}P. The method is not directly transferable to hard β-emitters; the sample geometry causes various wall effects. Reproducible results were obtained using a hanging strip geometry. The method is now being used for the ionophoretic study of various $^{32}P-^{35}S$-labeled phosphonates and phosphosulphonates, which will be reported separately. (auth)

12679 SYNTHESIS OF BENZENE OVER ACETIC ACID FOR THE LOW LEVEL MEASUREMENT OF TRITIUM COUNTS. Wolf, M. (Gesellschaft fuer Strahlen- und Umweltforschung mbh, Nuremburg). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 299-301(May 1973). (In German).

For tritium counting by liquid scintillation, water samples are usually converted to benzene via acetylene. The reaction of water with calcium carbide recovers only half the hydrogen for counting. To recover more, water was reacted with acetic anhydride to form acetic acid and acetylene was prepared from this. The count sensitivity is 20% higher than with benzene obtained by the old method. Counts on "zero" samples were in good agreement with those on commercial benzene or that prepared by the old method. Within the reproducibility of <2% there appears to be no isotope effect from 1 to 8 days' storage of the acetic acid. There might be one in the first 24 hours. The process yields less benzene but needs water (30 ml against 50 ml). (UK)

12680 DETERMINATION OF NANOGRAM AMOUNTS OF SULPHIDE BY RELEASE OF RADIOACTIVE IODIDE. Krivan, V.; Pahlke, S.; Toelg, G. (Max-Planck-Institut fuer Metallforschung, Schwaebisch Gmuend, Ger.). Talanta; 20: No. 4, 391-397(Apr 1973).

Two variants of a technique for determination of nanogram amounts of sulfide ions in liquid samples are presented. They are based on the replacement of radioactively labeled iodide from $Ag^{131}I$ by sulfide. In the first variant, suitable for small sample volumes, the labeled silver iodide is fixed on a filter paper disc, which is then shaken with the solution to be analyzed until equilibrium is attained. In the second variant, suitable for sample volumes up to 300 ml, the sample solution is passed through a filter paper disc carrying labeled silver iodide or through a labeled silver iodide precipitate. The amount of sulfide is determined from the activity of the released radioiodide by comparison with standards processed in the same way. The method is applicable to sulfide amounts greater than 5 ng and concentrations greater than 0.2 ppM. The interference by many common accompanying anions and cations was investigated. (auth)

Separation Procedures

12681 CESIUM REMOVAL FROM SODIUM BY CHARCOAL IN A THERMAL CONVECTION CAPSULE. Cooper, M. H. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 113-114(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12682 FAST SEPARATION FOR ANTIMONY PRODUCED IN HEAVY-ION INDUCED FISSION. Ahmed, A. K.; Newton, G. W. A.; Robinson, V. J. (Univ. of Manchester, Eng.). J. Radioanal. Chem.; 13: No. 1, 135-139(Jan 1973).

Fission fragments from heavy ion induced fission were stopped in thin magnesium foils. A fast procedure based on evolution of stibine was developed to separate the antimony isotopes embedded in the foil. A separation system, and a glass pressure filtration system was constructed for this purpose. The chemical yield measured by three independent methods was 80 to 90%. The degree of decontamination from other fission products was $>10^2$. The whole separation took eight minutes. (auth)

12683 NEW METHOD FOR THE RADIOCHEMICAL SEPARATION OF COPPER FROM FISSION PRODUCTS. Sahakundu, S. M.; Marathe, S. G.; Rao, V. K.; Bhargava, V. K.; Iyer, R. H. (Bhabha

Atomic Research Centre, Bombay). J. Radioanal. Chem.; 13: No. 1, 37-40(Jan 1973).

A new method for obtaining radiochemically pure ^{67}Cu from highly active fission product solutions is described. The method is based on the solvent extraction of the Cu(II) diethyldithiocarbamate complex in n-butyl acetate in the presence of hold-back carriers for Ni, Co, Mn, Mo, rare earths, Cd, Te, and Sb, and subsequent purification steps involving scavengings for Ag, Ba, Sr, and Fe followed by an anion-exchange purification step for decontamination from Te. Copper is finally extracted as the α-benzoin oxime complex in which form it is mounted and counted. The method has several advantages over other methods in that decontamination is very high and it is sufficiently fast considering the stringent radiochemical purity achieved. The ^{67}Cu separated by this procedure from a one-day-old mixture of fission products arising from 10^{10} fissions was found to be completely free of any contamination. (auth)

12684 EXTRACTION OF THE THIOCYANATO COMPLEXES OF Pa(V) AND Pa(IV) WITH TRIBUTYL PHOSPHATE. Nekrasova, V. V.; Palshin, E. S.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 14: No. 2, 87-93(15 Jun 1973).

Extraction of $^{233}Pa(IV)$ and $^{233}Pa(V)$ thiocyanato complexes with tributyl phosphate was studied. The composition of the extracted complexes is the following: $HPa(SCN)_5 \cdot 3TBP$; $Pa(OH)_3(SCN)_2 \cdot 3TBP$ and $PaOH(SCN)_4 \cdot 3TBP$. Also the extraction constants were calculated for these compounds. (auth)

12685 POLY-(4- AND 5-ACRYLAMIDOSALICYLIC ACIDS). Part 4. Selectivity in the Extraction of Metal Cations from Aqueous Solution. Kennedy, J. F.; Barker, S. A.; Nicol, A. W.; Hawkins, A. (Univ. of Birmingham, Eng.). J. Chem. Soc., Dalton Trans.; No. 11, 1129-1132(1973).

4- and 5-Aminosalicylic acids were converted into their N-acryloyl derivatives which underwent polymerisation in the presence of sodium and borate ions to give poly-(4- and 5-acrylamidosalicylic acids). These polymers act as solid-state chelating agents capable of selectively extracting specific cations from aqueous solution. Thus the polymers show appreciable selectivity for Fe^{3+} in the pH range 2.0 to 2.7, and for Cr^{3+}, UO_2^{2+}, and Cu^{2+} in the pH range 4.5 to 5.5; nearly 100% of each of these ions was extracted when a stoichiometric quantity of polymer was used. A maximum of ca. 30% of the ions Ni^{2+}, Co^{2+}, Zn^{2+}, and Mn^{2+} were extracted in the pH range 4.5 to 6.0. Cd^{2+} was extracted to ca. 50% in the pH range 4.5 to 5.5. (auth)

12686 ANION EXCHANGE BEHAVIOR OF URANIUM ALONG WITH OTHER METAL IONS IN THE MICROGRAM RANGE ON WOFATIT-SBU. Analytical Use of Acetic, Glycolic, Thioglycolic, Succinic, Malic, and Thiomalic Acids as Complex Formers. Guertler, O.; Chu-Xuan-Anh; Holzapfel, H. (Karl-Marx Univ., Leipzig). Acta Chim. Acad. Sci. Hung.; 75: No. 3, 227-233(1973). (In German).

The ion exchange behavior was studied of uranium(VI) along with thorium(IV) and other metal ions in the microgram range in the presence of acetic, glycolic, thioglycolic, succinic, malic, and thiomalic acids at various pH values. Also developed was a separation method for uranium(VI) in the presence of thioglycolic acid by column chromatography. In addition, the distribution coefficients were determined for U(VI), Th(IV), Mo(VI), Fe(II), Fe(III), Se(III), Y(III), Mg(II), Ca(II), Sr(II), and Ba(II) at pH values of 2.5 and 4 in the presence of the above listed acids with both batch and column procedures on WOFATIT-SBU and -SBW. (tr-auth)

12687 SORPTION OF RADIORUTHENIUM ON ION-EXCHANGE RESINS AND GLASS FROM FORMIC ACID SOLUTIONS OF METHANOL. Volkov, A. A.; Filatov, E. S. (Moscow State Univ.). Radiochem. Radioanal. Lett.; 14: No. 3, 169-173(30 Jun 1973).

The adsorption coefficients of ruthenium were calculated on the basis of experimental data for the methanol solution of ^{106}Ru in the presence of formic acid. $C_{ads.}$ (cations) on glass and cation-exchange resin displayed maxima at 2×10^{-4} M HCOOH. $C_{ads.}$ (anions) has minimum at the same concentration of HCOOH. The data are compared with the previously found molecular size dependence of particles in methanol solutions on the corresponding values of pH adjusted with HCl. The formation of polynuclear Ru-species was assumed. (auth)

12688 COMPLEX FORMATION AND EXTRACTION OF NIOBIUM(V) WITH THYRONE AND ANILINE. Ali-Zade, T. D.; Gamid-Zade, G. A.; Akhmedova, G. A. (Azerbaydzhan Inst. of Oil and Chemistry, Baku). Azerb. Khim. Zh.; No. 3, 156-159(1972). (In Russian).

The complex formed by Nb(V) with thyrone (pyrocatechol-3,4-disulfonic acid ester) and aniline in the ratio 1:1:3 was extracted by n-amyl alcohol and studied photometrically. The molar absorption coefficient = 7200, with λ_{max} = 440 nm. Beer's law held over the concentration range 5 to 200 μg Nb_2O_5 in 5 nm of extract. (KSW)

12689 EXTRACTION CHROMATOGRAPHY USING CHELATING. V. Separation of Hf(IV), Nb(V), Ta(V), and Pa(V) with N-Benzoyl-N-Phenylhydroxylamine. Sebesta, F.; Posta, S. (Technical Univ., Prague). Radiochem. Radioanal. Lett.; 14: No. 3, 183-191(30 Jun 1973).

The extraction-chromatographic behaviour of Hf(IV), Nb(V), Ta(V), and Pa(V) in the system N-benzoyl-N-phenylhydroxylamine–chloroform–hydrochloric and hydrofluoric acids was studied. The separations: $^{175+181}Hf-^{182}Ta$; $^{233}Pa-^{182}Ta$; $^{233}Pa-^{95}Nb$; $^{95}Nb-^{182}Ta$ and $^{233}Pa-^{95}Nb-^{182}Ta$ in this system are reported. (auth)

12690 EXTRACTION OF SULPHURIC ACID BY METHYL DIPHENYL PHOSPHATE AND TRIBUTYL PHOSPHATE. Apelblat, A. (Israel Atomic Energy Commission, Beersheba). J. Chem. Soc., Dalton Trans.; No. 11, 1198-1201(1973).

The extraction equilibria in the sulphuric acid–methyl diphenyl phosphate–water and sulphuric acid–tributyl phosphate–water systems were investigated. The activities of methyl diphenyl phosphate and tributyl phosphate were calculated in the range of aqueous 0 to 10 M-H_2SO_4, with the aid of the Gibbs–Duhem relationship. The experimental data found are consistent with the formation of the $[H(H_2O)_3(MePh_2PO_4)_4^+]$ $[HSO_4^-]$ complex with the equilibrium constant $K = 2 \times 10^{-3}$ (mol/kg $MePh_2PO_4)^{-1}$. At higher acid concentrations complete miscibility of $MePh_2PO_4$ and H_2SO_4 is observed. At low concentrations of H_2SO_4, the acid is extracted by tributyl phosphate in the form of $H_2SO_4(H_2O)_6$ $(Bu_3PO_4)_3$ with $K = 20$ (mol/kg $Bu_3PO_4)^{-3}$. Some summarizing remarks on the extraction of HNO_3, HCl, and H_2SO_4 by $MePh_2PO_4$ and Bu_3PO_4 are also given. (auth)

12691 LIQUID–LIQUID EXTRACTION OF LANTHANIDES USING PHOSPHORAMIDES. Gonnet, C.; Lamotte, A.; Porthault, M. (Lyon Univ., Villeurbanne, France). Bull. Soc. Chim. Fr.; No. 1, 45-47(Jan 1973). (In French).

Hexamethylphosphotriamide (HMPT) and hexabutylphosphotriamide (HBPT) were used to extract lanthanides from a molten nitrate medium or from an aqueous medium at 25°C. In both cases, the form of the complexes extracted by the compounds is ML_2 (L = HBPT or HMPT). The extraction equilibrium constants of the rare earth elements were determined. (France)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 13349.

Chemical and Physicochemical Properties

Refer also to abstracts 13221, 13371, and 13373.

12692 CITRACONIC ACID COMPLEXES OF ZrO(II), VO(II), AND UO_2(II). Krishnamacharyulu, J.; Seshaiah, U. V. (Coll. of Engineering, Anantapur, India). Indian J. Chem.; 10: No. 12, 1192-1193(Dec 1972).

The formation of 1:1 zirconyl, vanadyl, and uranyl citraconate complexes is reported. The stability constants of these oxocation chelates were determined by pH titration method. The stability constants of uranyl citraconate are compared with those of uranyl maleate and succinate. The presence of a double bond in the chelate ring of uranyl citraconate affords extra stability to the complex in comparison to uranyl maleate and uranyl succinate. (auth)

12693 FORCE CONSTANTS AND CALCULATION OF NORMAL VIBRATIONS OF THE ANION COMPLEX $(UO_2Cl_4 \cdot 2H_2O)^{2-}$ IN A CRYSTAL OF RUBIDIUM URANYL CHLORIDE. Fang Tin K'eng; Kovrikov, A. B.; Komyak, A. I. Zh. Prikl. Spektrosk.; 18: No. 3, 455-462(Mar 1973).

The symmetry D_{2h} of the complex ion $(UO_2Cl_4 \cdot 2H_2O)^{2-}$ in a crystal of $RbUO_2(NO_3)_3$ was evaluated for angles lying in the equatorial plane of the uranyl ion, and force constants were determined. The frequencies and forms of vibrations of this compound were calculated and good agreement obtained with those experimentally observed. (tr-auth)

12694 DETERMINATION OF THE STABILITY CONSTANTS AND DIPOLE MOMENTS OF COMPLEXES FORMED BETWEEN ISOPROPANOL AND SOME OF TRIALKYL PHOSPHATES. Waclawek, W.; Adamowski, L. (Technical Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 3, 233-238(1973).

The dipole moments μ_c and stability constants K of isopropanol with trimethyl, triethyl, triisopropyl, and tri-tertbutyl phosphates

were determined in carbon tetrachloride at 20°C. The simplified Few and Smith dielectric method was used. Variation of the μ_c and K values with the kind of alkyl group was explained in terms of two effects: (i) steric hindrance, which decreases the complexation by means of hydrogen bonding and can change the phosphate conformation and (ii) the inductive effect, which increases the electron density on the oxygen atom of the phosphoryl group. (auth)

Isotope Effects

Refer also to abstracts 12762 and 13286.

12695 STEREOSPECIFICITY, REGIOSELECTIVITY, AND KINETIC DEUTERIUM ISOTOPE EFFECTS IN THE SILVER(I)-CATALYZED ISOMERIZATIONS OF 1-METHYLTRICYCLO-[4.1.0.0]HEPTANES TO BICYCLO[3.2.0]HEPT-6-ENES. Zon, G.; Paquette, L. A. (Ohio State Univ., Columbus). J. Amer. Chem. Soc.; 95: No. 13, 4456-4458(27 Jun 1973).

Mechanistic pathways involved in the formation of 1,3-cycloheptadiene and alkylidenecyclohexene and the initial and ensuing stages that provide the bicycloheptene product were studied. Isotope effects were used in the collection of experimental evidence that indicates the complete stereoselectivity and moderate regioselectivity of this isomerization. (JGB)

12696 ISOTOPE EFFECT AND THE MOLECULAR MECHANISM OF THE SECOND VISCOSITY COEFFICIENT OF WATER. McLaughlin, E. (Louisiana State Univ., Baton Rouge). J. Phys. Chem.; 77: No. 14, 1801-1802(5 Jul 1973).

The sound absorption data in water and heavy water are analyzed to yield the second viscosity coefficient which is discussed in terms of the basic molecular mechanistic processes involved compared with those operative in shear viscosity. (auth)

12697 SEMIEMPIRICAL STUDY OF HYDROGEN BONDING IN THE BIFLUORIDE ION. Jiang, G. J.; Anderson, G. R. (Bowdoin Coll., Brunswick, ME). J. Phys. Chem.; 77: No. 14, 1764-1768 (5 Jul 1973).

A study of hydrogen bonding in the bifluoride ion is reported. A semiempirical potential energy function of the $[FHF]^-$ ion is defined and evaluated by a least-squares procedure using ab initio MO data recently reported by Almlöf and also by Kollman and Allen. The new potential function fits the data on the bifluoride ion better than the functions proposed earlier. Using the new potential function, vibrational eigenfunctions and eigenvalues are calculated for hydrogen and deuterium isotopes following the procedures of Anderson and Lippincott. Vibrational frequencies are computed and found to be in good agreement with spectroscopic results. (auth)

12698 ARRHENIUS PARAMETERS FOR THE REACTIONS OF HIGHER ALKYL RADICALS WITH SILANES. Berkley, R. E.; Safarik, I.; Strausz, O. P.; Gunning, H. E. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 77: No. 14, 1741-1747(5 Jul 1973).

Arrhenius parameters were measured for the hydrogen abstraction reactions of the ethyl radical with silane, silane-d_4, disilane, and disilane-d_6 and for the reactions of the n-propyl and isopropyl radicals with silane and silane-d_4 molecules. The A factors exhibit little variation and the activation energies follow the trend predicted by BEBO calculations only if it is assumed that the combination–disproportionation reactions of these radicals possess a small activation energy, ~3.6 kcal/mol for the ethyl, n-propyl, and the isopropyl radicals. Experimentally determined kinetic isotope effects at 100°C are tabulated. (auth)

12699 ARRHENIUS PARAMETERS FOR THE REACTIONS OF METHYL RADICALS WITH SILANE AND METHYLSILANES. Berkley, R. E.; Safarik, I.; Gunning, H. E.; Strausz, O. P. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 77: No. 14. 1734-1740 (5 Jul 1973).

Arrhenius parameters were measured for the hydrogen transfer reactions of methyl radicals with silane, methylsilanes, and their deuterated counterparts. The A factors all lie in the range of log A = 11.4 to 12.4 and the activation energies do not follow the trends in the Si–H bond energies. The bond-energy–bond-order method of estimating the potential energies of activation cannot be directly applied to these reactions. Experimental kinetic isotope effects for hydrogen abstraction by methyl radicals are tabulated. (auth)

12700 VIBRATIONAL SPECTRA OF SOME CAROTENOIDS AND RELATED LINEAR POLYENES. Raman Spectroscopic Study. Rimai, L.; Heyde, M. E.; Gill, D. (Ford Motor Co., Dearborn, MI). J. Amer. Chem. Soc.; 95: No. 14, 4493-4501 (11 Jul 1973).

The vibrational resonance Raman (RR) spectra of β-carotene and its synthetic homologs $C_{30}H_{44}$, $C_{35}H_{50}$, $C_{50}H_{68}$, and $C_{60}H_{80}$ of bixin, crocetin, capsanthin, the polyene antibiotic Amphotericin B (Fungizone), and of deuterio-β-carotene are presented. The spectra of bixin and crocetin, which are carotenoid chains stripped of ionone rings, are similar to those of β-carotene; thus the conjugated chain is identified as the main contributor to the RR spectra of all carotenoids. A theoretical model of in-plane vibrations in an infinitely long polyvinylene chain is used to prove that the frequency of the intense ethylenic mode at ~1500 cm^{-1} is a genuine measure of the stiffness of the C=C bonds (hence the frequency of the ethylenic mode is an indicator of bond alternation) and that the band at 1100 to 1200 cm^{-1} results from the admixture of C–C and C=C stretching with C–H bending, explaining why the observed frequency does not increase with the stiffening of the C–C bonds in the chain. For deuterio carotenoids the model calculation yields much less satisfactory mode assignments. Possible implications of this result are discussed. (auth)

12701 LARGE ISOTOPE IN THE SODIUM-MONACTIN COMPLEX. Raede, H. S.; Wagener, K. (Nuclear Research Center, Juelich, Ger.). Radiochim. Acta; 18: No. 3, 141-143(1972).

The isotope effect in the complex formation equilibrium of ^{22}Na and ^{24}Na with monactin was found to be 3.8%, which is about one order of magnitude larger than the kinetic isotope effects. This gives the possibility to cheque the physiological role of such selective ring compounds, as monactin, in active ion transport through biological membranes. (auth)

12702 NEUTRALIZATION OF NITROALKANE ANIONS WITH ACIDS IN H_2O AND D_2O. Masada, R. I. Seattle; Univ. of Washington (1972). 152p. University Microfilms Order No. 73-13,858.

Thesis (Ph. D.).

The neutralizations of the anions of nitromethane, nitroethane, 2-nitropropane and 1,1-dinitroethane with a variety of acids were studied. For each anion general acid catalysis was observed and for each acid the neutralization rate constant decreased in the order $CH_2 = NO_2^- > CH_3C(NO_2) = NO_2^- > CH_3CH = NO_2^- > (CH_3)_2C = NO_2^-$. A linear free energy relationship (Brønsted relation) between the neutralization rate constants and acid strength of the general acids was found. The alpha values were 0.45, 0.46, 0.48 and 0.49 for the anions of 1,1-dinitroethane, nitromethane, nitroethane and 2-nitropropane, respectively. Negative deviations from the Brønsted line were observed for diethylmalonic monoanion and hydrogen ion and positive deviations for pyridinium, and dihydrogen phosphate. Negative deviations for water were also found for nitroethane and 2-nitropropane anions. Neutralizations in deuterium oxide necessitated the measurements of the ionization constants of deuterioethanenitronic acid, deuterio-2-propanenitronic acid, and 1,1-dinitroethane-1-d. The isotope effects ranged from 2 to 9 and the lowest isotope effects were found for the reaction of hydrogen (deuterium) ion with each anion. The isotope effects increased as the acid strength of the nitroalkane approached the acid strength of the acid used ($\Delta pK = 0$). The primary isotope effects, the alpha values, and the lower rates found for the sterically hindered diethylmalonic monoanion all indicate that the transition state involves a direct proton transfer from donor to acceptor and that the bonds to the proton are roughly half broken and half made in the transition state. (Diss. Abstr. Int., B)

12703 PERACID OXIDATION OF IMINES. Kinetics of Oxazirane Formation From Benzylidene-Tert-Butylamines and Perbenzoic Acid. Ogata, Y.; Sawaki, Y. (Nagoya Univ., Japan). J. Amer. Chem. Soc.; 95: No. 14, 4687-4692(11 Jul 1973).

The reaction of perbenzoic acid (PBA) with benzylidene-tert-butylamines to afford oxaziranes was studied kinetically in order to decide whether the mechanism is either one step (epoxidation type) or two step (the Baeyer–Villiger type). Although the rates are summarized as $v = k_{obsd}[C=N][PBA]$, the reaction exhibits complex kinetics because of two adverse effects, acceleration by carboxylic acids and protic solvents and retardation by basic solvents including ethers and alcohols. Thus, various alcohols can catalyze the oxidation with similar effectiveness as carboxylic acids, while the reaction is retarded on addition of excess of some alcohols. The substituent effect on the imines changes with reaction conditions; the effect becomes very small in the presence of ethanol. These data for the oxazirane formation show behaviors different from the PBA oxidation of amines and olefins, which has a one-step mechanism. It may be concluded that the oxazirane formation has a two-step mechanism similar to the Baeyer–Villiger reaction, where the addition to C=N is rate determining under most conditions. Significant amounts of nitrones were also formed with imines bearing electron-donating substituents. Solvent deuterium effects observed in the oxidation of p-nitrobenzylidene-tert-butylamine are tabulated. (auth)

12704 E2C MECHANISM IN ELIMINATION REACTIONS. IV. Primary Hydrogen Isotope Effects. Biale, G.; Parker, A. J.; Stevens, I. D. R.; Takahashi, J.; Winstein, S. (Univ. of California, Los Angeles). J. Amer. Chem. Soc.; 94: No. 7, 2235-2239 (5 Apr 1972).

Primary hydrogen isotope effects (k^H/k^D) on the rate of some halide-induced dehydrotosylations of alkyl tosylates in acetone (E2C-like reactions) are 2.3 to 3.2. This is considerably less than for many E2 reactions promoted by strong hydrogen bases (E2H-like reactions). The dehydrotosylation of 3-methyl-2-butyl tosylate by sodium ethoxide in ethanol gives $k^H/k^D = 2.6$ for formation of the Saytzeff olefin, 2-methyl-2-butene, but k^H/k^D is 6 for formation of the Hofmann olefin, 3-methyl-1-butene. These observations confirm the need for a spectrum of E2 transition states, positions in the spectrum depending on the nature of the base and of the substrate. The β-hydrogen isotope effect on the rate of substitution reactions accompanying E2C-like reactions is negligible, i.e., $k^H/k^D = 1$, but there is a small isotope effect on the combined substitution and elimination reactions. This confirms that C_B-H bonding is different in the transition states leading to substitution and elimination products. The small kinetic isotope effects in E2C-like reactions do not distinguish between a nonlinear configuration, or an asymmetric linear configuration, of C_β, H_β, and base in the transition state but they are in accord with a paene olefin E2C-like transition state. (auth)

12705 KINETIC ISOTOPE EFFECTS IN THE OXIDATION OF ALCOHOLS BY SILVER CARBONATE. Kakis, F. J. (Chapman Coll., Orange, CA). J. Org. Chem.; 38: No. 14, 2536-2539 (13 Jul 1973).

The kinetic isotope effect resulting from the silver carbonate oxidation of a variety of alcohols was determined by a convenient double labeling technique which may be utilized for similar determinations in other systems. The method is especially suitable to systems where reproducible direct kinetic measurements are not possible. The theory strengths and limitations of the method are discussed and its validity is experimentally verified. (auth)

12706 CATALYTIC MODE, SOLVENT ISOTOPE EFFECTS, AND TRANSITION-STATE STRUCTURE IN HYDRIDE EXPULSION FROM SILICON. O'Donnell, K.; Bacon, R.; Chellappa, K. L.; Schowen, R. L.; Lee, J. K. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc.; 94: No. 7, 2500-2505(5 Apr 1972).

Triphenylsilane, tribenzylsilane, and tributylsilane are methanolyzed to hydrogen and the methoxysilanes in a specific methoxide catalyzed reaction ($\beta > 0.8$ for triphenylsilane, > 0.5 for tribenzylsilane, >0.7 for tributylsilane in phenol-phenoxide buffers). Deuterated silanes react more slowly by factors of 1.20 ± 0.08, 1.35 ± 0.09, and 1.40 ± 0.10, respectively. The protiated compounds have $\Delta G^*_{298} = 18.17 \pm 0.02$, 20.33 ± 0.02, 21.89 ± 0.02 kcal/mol, $\Delta H^* = 9.4 \pm 0.3$, 11.4 ± 0.3, 12.3 ± 0.5 kcal/mol, and $\Delta S^* = -29.5 \pm 1.8$, -30.0 ± 1.8, -32.1 ± 3.2 gibbs/mol, respectively. For triphenylsilane, the second-order rate constants k_n in mixtures of CH_3OH and CH_3OD (mole fraction n) are given by $k_n = k_0(1 - n + 0.22n)/(1 - n + 0.76n)^3$. The transition state strongly resembles a quinquevalent-silicon compound, the Si–H bond being strong and the H–H bond of the product still weak. The absence of a nonbonded electron pair on the leaving group prevents electrophilic assistance by prior-protonation or solvation-catalysis mechanisms, forcing concerted donation of a solvent proton to the hydride in the course of its departure. Proton transfer to this very basic species is little advanced in the transition state so that the reaction is unselective and general acids do not compete with solvent. (auth)

12707 OXYGEN-18 ISOTOPE EFFECT IN THE HYDROLYSIS OF 2,4-DINITROPHENYL PHOSPHATE. A Monomeric Metaphosphate Mechanism. Gorenstein, D. G. (Univ. of Illinois, Chicago). J. Amer. Chem. Soc.; 94: No. 7, 2523-2525(5 Apr 1972).

The ester–oxygen ^{18}O isotope effect for the hydrolysis of the dianion of a monoaryl phosphate ester is reported that represents supporting evidence for the metaphosphate mechanism. Since no discernible trend in the isotope effect in the temperature range 39 to 55°C and the pH range 4.4 to 8.0 in any buffer solution was observed, all values were statistically analyzed together to give an isotope effect of 1.0204 ± 0.0044. Since this value is more than four standard deviations from unit, it can be stated with greater than 99% confidence that at least some isotope effect is experimentally verifiable. (DHM)

12708 ISOTOPE EFFECT OF AROMATIC COUPLING REACTION CATALYZED BY PALLADIUM ACETATE. Kashima, M.; Yoshimoto, H.; Itatani, H. (Polymer, Research Lab., Ichara-shi, Japan). J. Catal.; 29: No. 1, 92-98(Apr 1973).

Isotope effect in palladium catalyzed coupling reaction of aromatic compounds was measured under oxygen pressure as well as under atmospheric pressure. For deuterobenzene, a large isotope effect (k_H/k_D) was found to be 2.1 to 2.5 at 150°C under oxygen pressure and to be 4.1 to 5.1 at room temperature under atmospheric pressure. On the basis of these isotope effects, the two-step hydrogen abstraction mechanism was proposed. Under oxygen pressure, oxygen plays an important role in the reoxidation of reduced palladium(O) complex. (auth)

12709 ANOMALOUS HEAT CAPACITIES OF SUPERCOOLED WATER AND HEAVY WATER. Rasmussen, D. H. (Cryobiology Research Inst., Madison, WI); MacKenzie, A. P.; Angell, C. A.; Tucker, J. C. Science; 181: No. 4097, 342-344(27 Jul 1973).

Emulsification makes it possible to supercool water to the homogeneous nucleation temperature. Accordingly, the heat capacities of water and deuterium oxide were determined from the respective equilibrium melting points to −38° and to −34°C, respectively. Two methods, drift calorimetry and differential scanning calorimetry, were used. Both methods reveal a striking rise in the constant-pressure heat capacity below −20°C. This indication of an apparently cooperative behavior should serve to test current theories of water, most notably perhaps, the pair potential model of Ben-Naim and Stillinger. Some implications of possible meteorological significance are mentioned. (auth)

12710 KINETIC ISOTOPE EFFECTS FOR THE REDUCTION OF A VARIETY OF PENTAAMMINECOBALT(III) COMPLEXES BY CHROMIUM(II) AND VANADIUM(II). Itzkowitz, M. M. Rochester, NY; Univ. of Rochester (1972). 96p. University Microfilms Order No. 73-14,814.

Thesis (Ph.D.)

The k_H/k_D ratios obtained for the chromium(II) reductions of the following pentaamminecobalt(III) complexes are 1.50 (pyridine), 1.45 ± 0.03 (nicotinamide), 1.1 (isonicotinamide), 1.11 ± 0.02 (4-pyridinecarboxylato, acid independent path), 1.05 ± 0.43 (4-pyridinecarboxylato, inverse acid path), 1.26 ± 0.05 (fumarato, acid independent path), 1.02 ± 0.03 (fumarato, acid path), 1.10 ± 0.04 (azido), 1.58 ± 0.10 (hydroxo), 1.41 ± 0.11 (cyano), 1.34 ± 0.07 (isothiocyanato), and 1.48 ± 0.03 (acetato). The k_H/k_D ratio obtained for the acetato system where essentially only the trans ammine was deuterated is 1.60 ± 0.07 (again corrected to 15 ammine deuteriums). The k_H/k_D ratios obtained for the vanadium(II) reductions of the following pentaaminecobalt(III) complexes are 1.54 (pyridine), 1.44 ± 0.06 (nicotinamide), 1.16 ± 0.02 (isonicotinamide), 1.54 ± 0.03 (aquo), 1.04 ± 0.04 (azido), and 1.41 ± 0.05 (isothiocyanato). (DHM).

Isotope Exchange and Isotope Separation

12711 (COO-3148-5) ACIDIC BEHAVIOR OF CHLOROFORM. Margolin, Z.; Long, F. A. (Cornell Univ., Ithaca, N. Y. Dept. of Chemistry). 1972. 27p. Dep. NTIS $3.50.

The detritiation of chloroform in aqueous buffer solutions involves only hydroxide ion; general base catalysis is not observable. No reaction with water is observable at either 25 or 50°C. The rate coefficient for the hydroxide ion reaction is 0.165 M^{-1} sec^{-1} at 25°C, implying that the pK of chloroform is about 24. The primary hydrogen isotope effect for the proton removal process, determined by a new accurate method, is $k^H/k^D = 1.42$ at 25°. The entropy of activation for the aqueous detritiation by hydroxide is strongly positive; ΔS^* at 25° is +15 eu, about 25 eu above normal for k values in M^{-1} sec^{-1} units. This value drops sharply as DMSO is added to the reaction system implying that desolvation of hydroxide ion is a major contributor to the positive entropy. The Brønsted β for the hydroxide ion reaction, as determined in DMSO–H_2O solvent mixtures using the Bell and Cox procedure, is 0.98. These several data strongly suggest that the proton removal reaction of chloroform is fully normal in the Eigen sense, even for reaction with hydroxide ion. This result is in considerable contrast to most other carbon acids, including the otherwise normal cyanocarbons, in that hydroxide reaction is usually anomalously slow and Brønsted coefficients often differ considerably from the limiting values of zero and unity. (auth)

12712 (LA-UR-73-690) LARGE-SCALE PHOTOSYNTHETIC PRODUCTION OF CARBON-13 LABELED SUGARS. Kollman, V. H.; Gregg, C. T.; Hanners, J. L.; Whaley, T. W.; Ott, D. G. (Los Alamos Scientific Lab., N. MEX). 1973. W-7405-eng-36. 25p. (CONF-730525-2). Dep. NTIS $3.25.

From conference on stable isotopes in chemistry, biology and medicine; Argonne, Illinois, USA (9 May 1973).

A large-scale preparation of uniformly ^{13}C labeled sugars using young, mature leaves from tobacco, Swiss chard, canna plants, and thalli of marine red algae is described. The tobacco system produces primarily starch with lesser amounts of free glucose, fructose, and sucrose. Swiss chard and cannas produce the three simple carbohydrates. Galactose and glycerol are obtained from the marine red alga Gigartina. (DHM)

12713 ROLE OF BISULFITE IN THE DEAMINATION AND THE HYDROGEN ISOTOPE EXCHANGE OF CYTIDYLIC ACID. Sono, M.; Wataya, Y.; Hayatsu, H. (Tokyo Univ.). J. Amer. Chem. Soc.; 95: No. 14, 4745-4749(11 Jul 1973).

The mechanism of the bisulfite-catalyzed deamination and hydrogen isotope exchange of cytidine 5′-phosphate (CMP) was investigated by kinetic studies. The deamination which proceeds by the sequence, CMP + HSO_3^- ⇌ CMP-bisulfite adduct (CMP−SO_3^-) → UMP-bisulfite adduct (UMP−SO_3^-), showed pseudo-first-order kinetics in the presence of a large excess of bisulfite. Apparent rate constants for CMP → UMP−SO_3^- were determined, and the pH profile of the rate exhibited its maximum at pH 5. At pH 5 and 37° the rate constant, for example in 3 M sodium bisulfite solution, was 26.2×10^{-5} sec^{-1}. Examination of the relationship between the rate and bisulfite concentration has shown that the relative rate, k/k in 1 M $NaHSO_3$, is proportional to $K_E[NaHSO_3]^2/(1 + K_E[NaHSO_3])$, where K_E is the experimentally measurable equilibrium constant for CMP ⇌ CMP−SO_3^-. This relationship indicates that bisulfite ion participates in the hydrolysis of CMP−SO_3^- to UMP−SO_3^- in addition to the adduct-forming step CMP → CMP−SO_3^-. Deamination of cytidine by bisulfite action is similar to that of CMP with respect to pH profile and dependence on bisulfite concentration, although the reaction velocity is somewhat greater than that for CMP. Ammonium sulfite is a more preferable agent than sodium sulfite in order to obtain a faster reaction because the ammonium salt is more soluble than the sodium salt and ammonia exhibits an accelerating effect upon the deamination of CMP. Bisulfite-catalyzed hydrogen−deuterium exchange at the 5 position of CMP showed a pD maximum at 5.4 where the deamination concomitantly occurring was also maximal. Furthermore, dependence of the exchange rate on bisulfite concentration showed the same characteristic as that of the deamination. It was therefore concluded that two molecules of bisulfite were participating in both the deamination and the isotope exchange of a molecule of CMP. (auth)

12714 TRITIUM ISOTOPE FRACTIONATION BETWEEN PYRIDINIUM PERCHLORATE AND HYDROGEN CHLORIDE. Szydlowski, J. (Univ., Warsaw). RRALA; 14: No. 3, 155-159 (30 Jun 1973).

Tritium isotope effect on equilibrium of exchange reaction between gaseous hydrogen chloride and solid pyridinium perchlorate was studied. The anomalous temperature dependence of fractionation factor of tritium between these two components was observed. The possible causes of such dependences are briefly discussed. (auth)

12715 THEORY OF SEPARATION OF ISOTOPIC IONS BY TWO-DIMENSIONAL PARTITION ELECTROCHROMATOGRAPHY. Tikhomirov, I. A.; Tikhonov, G. S.; Gofman, E. R. (Tomsk Polytechnic Inst., USSR). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 12, 2804-2807(Dec 1972).

Translated from Zh. Prikl. Khim.; 45: No. 12, 2670-2673(Dec 1972).

A study was made on the theory of two-dimensional separation of isotopic ions by partition electrochromatography, with the use of a mixed aqueous−organic solvent as the mobile phase and an inert filler, quartz sand, as packing. The formulas derived can be used for calculating the main parameters of isotope separation with the aid of two-dimensional partition electrochromatography. Experimental and calculated values for the separation of isotopes of light alkali metals were compared, and found to be in good agreement. Maximum deviation did not exceed 5%. (JGB)

12716 PROBLEMS IN LABELING DIFFERENT ALBUMINS WITH IODINE ISOTOPES. Kocsar, L.; Meretey, K.; Kutas, V. (Sugarbiologiai es Sugaregeszseguegyi Kutato Intezet, Budapest). Izotoptechnika; 16: No. 4, 209-241(Apr 1973). (In Hungarian).

Advantages and disadvantages of chemical and electrolytic labeling are reviewed. Removal of free iodine with palladium is also considered. (auth)

12717 THERMODYNAMIC STUDIES OF HETEROGENEOUS LITHIUM ISOTOPE-EXCHANGE REACTIONS. Singh, G. Davis, CA; Univ. of California (1972). 158p. University Microfilms Order No. 73-8353.

Thesis (Ph.D.).

The experimental determinations of the equilibrium constant for the lithium isotope-exchange reactions $^7Li(S) + {}^6Li^+(PC) = {}^6Li(S) + {}^7Li^+(PC)$ and $^7Li(S) + {}^6Li^+(H_2O) = {}^6Li(S) + {}^7Li^+(H_2O)$, where propylene carbonate (PC) and water are solvents, were carried out in electrochemical double and quadrupole cells without liquid junctions of the type $^7Li(S)|^7LiBr(PC)|TlBr(S)|Tl(Hg)|TlBr(S)|^6LiBr(PC)|{}^6Li(S)$ and $^7Li(S)|^7LiBr(PC)|^7Li(Hg)|^7LiCl(H_2O)|Hg_2Cl_2(S)|Hg(l)|-Hg_2Cl_2(S)|^6LiCl(H_2O)|^6Li(Hg)|^6LiBr(PC)|^6Li(S)$, respectively. The ϵ^0_{ex} values found for the isotope-exchange reactions are (23.5°C), $\epsilon^0_1 = 0.76 \pm 0.13$ mV and $\epsilon^0_2 = 1.16 \pm 0.30$ mV, respectively. The equilibrium constants calculated from these are $K_1 = 1.030 \pm 0.005$ and $K_2 = 1.046 \pm 0.013$, respectively. Also ϵ^0 and hence K were measured; $\epsilon^0 = 1843.54 \pm 3.2$ mV, $K = (2.096 \pm 0.28) \times 10^{31}$ for the reaction Li(S) + TlBr(S) = LiBr(PC) + Tl(S). The activity coefficients for LiBr(PC) are also reported. The equilibrium constants K_1 and K_2 have been calculated for various simple but realistic models for the reactions using statistical thermodynamics. The agreement between experimental and theoretical numbers is excellent. These calculations also give some insight into the nature of the solute−solvent interactions. In propylene carbonate, lithium ions can be treated by the particle-in-a-box model, whereas in water this simple model does not work and the lithium ions are treated as tetrahedrally hydrated species. (Diss. Abstr. Int., B)

Feed Materials Processing

12718 REMOVAL OF PLUTONIUM FROM PLUTONIUM HEXAFLUORIDE−URANIUM HEXAFLUORIDE MIXTURES. Golliher, W. R.; Harris, R. L.; LeDoux, R. A. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,708,568. 2 Jan 1973. Filed date 20 Oct 1970. 4p.

A method is described of selectively removing plutonium values from a fluid mixture containing plutonium hexafluoride and uranium hexafluoride by passing the mixture through a bed of pelletized cobaltous fluoride at a temperature in the range 134 to 1000°F to effect removal of plutonium by the cobaltous fluoride. (Official Gazette)

Radiation Chemistry

Refer also to abstract 12747.

12719 (SRO-640-6) RADIOLYSIS OF WATER IN A WIDE RANGE RADIOLYSIS SOURCE. Progress Report, September 1, 1972−August 31, 1973. Melton, C. E. (Georgia Univ., Athens. Dept. of Chemistry). 15 Jun 1973. Contract AT(38-1)-640. 25p. Dep. NTIS $3.25.

A comprehensive study on the formation of negative ions in nitric oxide, primary as well as secondary, was made. Three ions, O^-, NO^-, and NO_2^- were observed. The appearance potential of O^- is 7.0 eV. A maximum cross section of 1.2×10^{-18} cm^2 $molecule^{-1}$ was observed at 8.0 eV. The ions NO^- and NO_2^- are produced by thermonuclear reactions of the type $(NO)_2 + e \rightarrow NO^- + NO$ and $O^- + (NO)_2 \rightarrow NO_2^- + NO$. An unusually large rate constant of 7.6×10^{-27} cc^3 sec^{-1} was observed for the termolecular reaction producing NO_2^-. Mixtures of NO and H_2O were studied to determine the mechanism of the action of NO in electron radiolysis reactions. In addition to the O^-−NO reaction, a charge transfer reaction $H^- + NO \rightarrow H + NO^-$ was observed with a rate constant of $k = 3.4 \times 10^{-9}$ cc $molecule^{-1}$ sec^{-1}. The experimental value of the rate constant is in excellent agreement with the theoretical value derived on the assumption of locked-dipole ion−molecule interactions. This study shows that NO scavenges negative ions in H_2O with a corresponding increase in the abundance of free radicals (H atoms). (auth)

12720 ELECTRONIC SPECTRA OF TRAPPED ELECTRONS IN ORGANIC GLASSES AT 4°K. V. Aliphatic Amines. Ito, T. (Nagoya Univ., Japan); Fueki, K.; Namiki, A.; Hase, H. J. Phys. Chem.; 77: No. 14, 1803-1805(5 Jul 1973).

Optical absorption measurements were carried out on trapped electrons in aliphatic amine glasses at 4 and 77°K. A slight red shift or no shift of the absorption spectrum at 4°K relative to that at 77°K was observed for trapped electrons in several amines. The wavelength at the absorption maximum in the optical spectra at 77°K is generally correlated to matrix polarity. A comparison is also made between the efficiency of trapping at 4°K and that at 77°K for some of the amines. (auth)

12721 RADIOLYSIS OF TBP−DILUENT−HNO_3 SYSTEMS. III. The Relationship Between the Z-Number and the Dose and Post-Irradiation Effects. Nowak, Z. (Instytut Badan Jadrouych, Warsaw). Nukleonika; 18: No. 4, 159-164(1973). (In Polish).

The relationship between the zirconium retention by the irradiated system, TBP 30%−diluent−HNO_3 and the dose of gamma radiation, was also examined. It was established that the relationship of Z-numbers versus gamma dose is not linear and depends on the concentration of nitric acid in the irradiated system. The marked change in zirconium retention value in relation to the post-irradiation effects was found for systems irradiated in low concentrations of nitric acid <1 M. (auth)

12722 RADIOTHERMOLUMINESCENCE OF ICE IN THE PRESENCE OF ADDED SUBSTANCES. Ershov, B. G.; Puntezhis, S. A.; Pikaev, A. K.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 4, 889-892(1973). (In Russian).

The influence of the matrix structure of ice on the stabilization

of electrons was investigated by exposing ice to ^{60}Co-emitted γ radiation at 77°C and subsequently determining the radiothermoluminescence curves up to about 200°K. The curves for pure ice were compared with similar curves for 0.1 M solutions in H_2O of CH_3OH, LiOH, NaOH, KOH, and HF. HF caused the disappearance of the 158°K pure-ice peak and alkalies decreased its relative intensity. The 113°K-peak showed little change. These phenomena are discussed relative to the formation of radiolytic H_2O_2, HO_2 radicals, the energies of activation of the luminescence (6 and 9 kcal/mole for the 113 and 158°K peaks, respectively), and electron recombination. (KSW)

12723 DEPENDENCE OF O_3^- DECAY REACTION ON TEMPERATURE INVESTIGATED BY FLASH PHOTOLYSIS TECHNIQUE. Zagorski, Z. P.; Stuglik, Z.; Grodkowski, J. (Inst. of Nuclear Research, Warsaw). Rocz. Chem.; 47: No. 3, 571-578 (1973). (In Polish).

Temperature coefficient of O_3^- decay was measured. O_3^- was generated by intensive pulse of light in alkaline solutions containing hydrogen peroxide and oxygen ($O^- + O_2 \rightarrow O_3^-$). Activation energy at room temperature is 12.2 kcal/mole. (auth)

12724 GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ON HENEQUEN BY IRRADIATION USING HIGH-ENERGY ELECTRONS. Uribe Rendon, R. M. Mexico City; Universidad Nacional Autonoma de Mexico (1973). 132p. (In Spanish).

Thesis.

On irradiating henequen fibers with 1-MeV electrons or with ^{60}Co gamma rays and then submerging them in a solution of methyl methacrylate and methanol (MMA–M) a graft copolymer of methyl methacrylate on henequen was formed. The percentage of grafting is less than that obtained by others in the system MMA–cellulose, but it is possible to apply this process on a larger scale by a further study of increasing the percentage of grafting. The effect of radiation on the henequen fibers was investigated by means of EPR, by obtaining the reaction velocity of the radicals in air, methanol, and methyl methacrylate–methanol, and by further discussion of the absorption signal from EPR. (tr-auth)

12725 ULTRAVIOLET- AND γ-RAY-INDUCED REACTIONS OF NUCLEIC ACID CONSTITUENTS WITH ALCOHOLS. On the Selectivity of These Reactions for Purines. Leonov, D.; Salomon, J.; Sasson, S.; Elad, D. (Weizmann Inst. of Science, Rehovoth, Israel). Photochem. Photobiol.; 17: No. 6, 465-468(Jun 1973).

Preliminary results are presented of an investigation of uv and x-ray induced reactions of alcohols with a variety of purines and pyrimidines. Studies were made of the photochemical reactions of uracil, thymine 1,3-dimethyluracil (DMU) and 1,3-dimethylthymine (DMT) with 2-propanol in the presence of a variety of photosensitizers. Experiments involving the reactions of 2-propanol with various mixtures of these bases in the presence of di-tert-butyl peroxide (DBP) showed that with the exception of uracil, the pyrimidines and their nucleosides were almost unreactive, whereas the competitive purine had reacted with the alcohol to a considerable extent under the reaction conditions. It is suggested that these results indicate that the purines might be more prone to photochemical alterations than pyrimidines and thus might be the selective target for photochemical (or free radical) lesions in nucleic acids. It is also suggested that purines may play an important role in the interaction of nucleic acids with their environment under irradiation. (UK)

12726 RADIOLYTIC AND THERMAL DEGRADATION OF DODECANE–30% TBP–HNO_3 SYSTEMS. Nowak, Z.; Nowak, M. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 14: No. 3, 161-168(30 Jun 1973).

Three ways of degradation of n-dodecane–30% TBP–HNO_3 systems were studied; thermal degradation, γ-irradiation and uv-illumination. On the basis of Z-number of the samples, the yield of HDBP and the yield of paramagnetic species were shown that marked differences exist between thermal and radiolytic degradation. (auth)

12727 RADIATION INDUCED OXIDATION OF Sb(III) IN AQUEOUS SOLUTIONS. Effect of Water Miscible Alcohols. Souka, N.; Haggag, A. (Atomic Energy Establishment, Cairo). Radiochem. Radioanal. Lett.; 14: No. 3, 199-205(30 Jun 1973).

The radiolysis of antimony in sulfuric acid solutions containing different alcohols was investigated. The effect of these alcohols on the oxidation yield was discussed. A kinetic analysis of the experimental data enabled a calculation of the rate of reaction of the hydroxyl radical with some of the used additives. (auth)

12728 APPARATUS FOR SPECTROPHOTOMETRIC MEASUREMENTS ON AN AQUEOUS SAMPLE AT HIGH TEMPERATURES AND PRESSURES DURING IRRADIATION. Brown, M. (Imperial Coll. of Science and Tech., London). J. Phys., E (London); 6: No. 7, 639-644(Jul 1973).

An apparatus is described for the measurement of the optical absorption of aqueous samples, in the wavelength range 200 to 800 nm, at pressures and temperatures up to 100 MP and 900°K during γ irradiation from a ^{60}Co source. The application to radiation chemistry studies on the primary products of radical–scavenger reactions is described and an extension to the measurement of steady state free radical concentrations suggested. (auth)

12729 YIELD OF EXCITED SINGLET AND TRIPLET STATES IN THE PULSE RADIOLYSIS OF TOLUENE. Baxendale, J. H.; Rasburn, E. J. (Univ. of Manchester, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 4, 771-775(1973).

The 100-eV yield of the excited singlet state of toluene following a pulse of 10-MeV electrons is found to be 1.35, and the rate constant for its reaction with naphthalene to give the excited naphthalene singlet is 5.4×10^{10} M^{-1} s^{-1}. The corresponding yield of the triplet state of toluene is 2.8 and assuming it reacts with naphthalene at a normal diffusion controlled rate, its half-life is calculated to be 17 ns. (auth)

12730 MOLECULAR MOTION IN POLYISOBUTYLENE BY RADIOTHERMOLUMINESCENCE METHOD. Mindiyarov, Kh. G.; Zelenev, Yu. V.; Bartenev, G. M. (Moscow State Pedagogical Inst.). Vysokomol. Soedin., Ser. A; 14: No. 11, 2347-2353(Nov 1972). (In Russian).

The molecular motion in amorphous and crystallized polyisobutylene (PIB) was studied by the radiothermoluminescence method (RTL). The luminescence curve of γ-irradiated (at 77°K with a dose of 1 Mrad) PIB samples at a heating rate of 10 to 12 deg/min shows a sharp maximum in the region of −52°C corresponding to defreezing of segmental mobility in this polymer. The PIB samples crystallized with stretching and cooling show one more luminescence maximum in the region −80°C, which seems to be due to the mobility of chain ends in the crystalline regions of PIB and is similar to the γ-transition characteristic of partly crystalline polymers. The temperature dependence of the line width δH of the NMR spectra of crystallized PIB exhibits (in addition to transitions known for this polymer) a region of a smooth change of δH in the range −100 to 25°C. In the dependence of the spin-lattice relaxation time T_1 on temperature there is also an additional unpronounced maximum at −10°C. (auth)

12731 DEGRADATION OF ACID DYES BY IRRADIATION PLUS OXIDATION. Morris, R. D.; Craft, T. F. (Georgia Inst. of Tech., Atlanta). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 245-252(May 1973).

Solutions of Acid Yellow 40, Acid Blue 23, Acid Red 18, and Acid Blue 158, chosen as representatives of acid dyes, were readily decolorized by treatment with sodium hypochlorite and γ radiation. Decolorization usually occurred more rapidly at pH 4.0 than at pH 6.5 or 8.5. Several transient degradation products were separated by thin layer chromatography at various stages of treatment. No regular pattern of formation of degradation products was observed at any pH or after any particular interval of irradiation. (auth)

12732 SOLUTE TRIPLET FORMATION IN PULSE RADIOLYSIS: DEPENDENCE OF CAMPHORQUINONE TRIPLET FORMATION ON DONOR ENERGY. Sing, A.; Vaish, S. P.; Quinn, M. J. (Atomic Energy of Canada Ltd. Pinawa, Manitoba). Chem. Phys. Lett.; 19: No. 1, 57-60(1 Mar 1973).

Solute triplet formation is observed in solutions of naphthalene in isopropanol but not in those of camphorquinone. The camphorquinone triplet is formed if naphthalene is also present in the solutions. It is postulated that the efficiency of formation of the camphorquinone triplet depends upon the donor energies of electronically excited solvent molecules; the efficiency decreases with increasing donor energy. Results indicate that a higher excited state is the donor species in isopropanol. (auth)

12733 RADIATION INDUCED HYDROESTERIFICATION OF N-OCTENE (1) IN THE PRESENCE OF DICOBALTOCTACARBONYL AS A CATALYST. Saus, A.; Masoji, S. (Technische Hochschule, Aachen). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 271-279(May 1973). (In German).

The cobalt carbonyl catalyzed hydroesterification of n-octene-(1) with carbon monoxide and methanol in presence of ^{60}Co γ radiation (3×10^6 rad) gives high yields of alkanoic methyl esters using pressures of 75 to 250 atm and temperatures of up to 100°C. With n-octene-(1) a conversion of 92% of the olefin was achieved at 75 atm and 100°C (61% without irradiation). The reaction product was an isomeric mixture containing 99% of octanic acid methyl ester (95% without irradiation), equivalent to an ester yield of 91% (58% without irradiation). The isomeric mixture of octanoic acid methyl ester consisted approximately of 70% octanoic acid methyl ester-(1), 20%-(2), 6%-(3) and 4%-(4) independent of the

reaction conditions used. Increasing the radiation dose results in higher yields without any influence on the composition of the reaction product. In all cases the unreacted olefin was recovered in its original form without any signs of isomerization. (auth)

12734 BASE AND ACID CATALYZED PROTONATION OF ACRYLATE RADICAL DIANION AT THE β POSITION. Spectral and Kinetic Evidence. Hayon, E. (Army Natick Labs., MA). J. Amer. Chem. Soc.; 95: No. 14, 4762-4763(11 Jul 1973).

Results of a spectral and kinetic study of the pulse radiolytic reaction of the hydrated electron, e^-_{aq}, with acrylic acid and acrylate ion and of the subsequent protonation reactions of these radical anions are reported. Data show that in neutral aqueous solutions the acrylate radical dianion undergoes protonation on the carboxyl group. In alkaline solutions, the dianion radical undergoes protonation at the β carbon, the reaction being catalyzed by hydroxide ions. Second order rate constants for the protonation of the acrylate radical dianion in water by various buffers are tabulated. (JGB)

12735 RADIATION CHEMISTRY OF DIMETHYLSULFOXIDE. Cooper, T. K. Vancouver, B. C.; Univ. of British Columbia (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

A comprehensive study of the radiation chemistry of dimethyl sulfoxide (DMSO), and DMSO–H_2O mixtures, by steady-state γ-radiolysis, pulse radiolysis and low temperature matrix isolation techniques has revealed several significant features about the transient ionic products of the radiolysis. Very short-lived ($\tau_{\frac{1}{2}} < 25$ nsec), weakly bound solvated electrons are formed in quite high yields in these liquids at room temperature. Solvated electrons in the binary DMSO–H_2O mixtures exhibit single optical absorption bands with maxima which vary smoothly with composition from pure water ($\lambda_{max} = 720$ nm) to pure DMSO ($\lambda_{max} > 1500$ nm). The electron stability varies with composition, showing a minimum lifetime coinciding with DMSO–H_2O mixtures which exhibit maximum inter-molecular structure. In glassy mixtures at 77°K, electrons generated radiolytically or photochemically are not trapped and stabilized. The positive ions formed from irradiated DMSO are longer lived ($\tau_{\frac{1}{2}} \sim 2$ μsec) than the solvated electrons and have a strong absorption band centered at $\lambda_{max} \sim 550$ nm. In DMSO–H_2O mixtures this same absorption band is formed. The cationic yield is directly proportional to the fraction of the total dose absorbed initially by DMSO which suggests there is no charge transfer, proton exchange or positive ion scavenging in these mixtures. The yield of both e^-_s and cations was ~30% higher in the fully deuterated DMSO than in the hydrogenated material indicating some alteration in the electron escape probability due to isotopic substitution. A variety of free radicals were observed by electron spin resonance in γ-irradiated polycrystalline DMSO at 77°K amongst which the $\cdot CH_3$ and a sulfur containing radical are distinguished. Under γ-radiolysis liquid DMSO produces H_2, CH_4, C_2H_6, and $(CH_3)_2S$ with G values of 0.20 ± 0.01, 3.3 ± 0.1, 0.49 ± 0.03 and 1.2 ± 0.2 respectively. (Diss. Abstr. Int., B)

12736 DEVELOPMENT OF RADIOANALYTICAL METHODS. Szabadvary, F. (Budapesti Mueszaki Egyetem Altalanos Kemiai Tanszek). Izotoptechnika; 16: No. 4, 179-185(Apr 1973). (In Hungarian).

12737 PREPARATION OF INSOLUBLE ENZYMES BY HIGH-ENERGY IRRADIATION. Dobo, J. (Mueanyagipari Kutato Intezet, Budapest). Izotoptechnika; 16: No. 4, 215-222(Apr 1973). (In Hungarian).

Fixation of enzymes to an insoluble grid of polymer gel by irradiation is reported. The determination of enzymatic activity is also considered. (auth)

12738 DIRECT SYNTHESIS OF GRAFT POLY(VINYLIDENE CHLORIDE) ORIENTED STRUCTURES IN ORIENTED POLYMERIC MATERIALS. Kurilenko, A. I.; Krul, L. P.; Gerasimov, V. I.; Kalinin, V. N. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk SSSR; 209: No. 3, 649-651(1973). (In Russian).

The structures of oriented films of amorphous poly(methyl methacrylate) (PMMA) and crystalline polyethylene (PE) with grafted poly(vinylidene chloride) (PVDC) were contrasted with a view to interpreting the effects of orientation. The polymers were oriented by drawing at 95°C. PVDC was grafted by irradiating the film with γ-rays in a gaseous monomer at 20°C. X-ray studies showed that the grafted films possessed a heterogeneous structure; the discrete grafted structures were distributed throughout the matrix. Changes in the properties of the polymeric films are discussed. (KSW)

12739 OVERLAPPING OF SPURS AND THE RADIATION YIELDS OF RADIOLYSIS. I. Theoretical Estimation of the Effect of the Dose Rate of Irradiation on the Ratio of Radical to Molecular Radiation Yield. Stolarczyk, L. (Inst. of Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 3, 221-225(1973).

A simple model is proposed to estimate the title effect. The model is uniradical, the differences of "spurs" (blobs, short tracks) volume and shape are neglected and an average volume and time of life of spurs are postulated in it. The model makes it possible to take into account the overlapping of spurs. The model suggests that the above-mentioned ratio is expressed by the formula $G_R/G_M = G^0_R/G^0_M$ (1/1 + Z); where Z is proportional to the dose rate of the irradiation. (auth)

12740 EFFECT OF TEMPERATURE ON THE RADICAL YIELDS IN GAMMA RADIOLYSIS OF AQUEOUS SOLUTIONS OF NITRATES. Kalecinski, J. (Inst. for Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 3, 209-213(1973).

Radical yields in the γ-radioinduced reduction of aqueous nitrate solutions were studied at various temperatures (20 to 195°C) both in pure potassium nitrate solutions and in potassium nitrate–ethanol solutions. The radical yields were calculated on the basis of data obtained. It was found that G_{OH} is constant and G_{red} increases with temperature. (auth)

12741 POSITIVE-ION REACTION MECHANISM FOR THE RADIATION INDUCED OXIDATION OF CARBON MONOXIDE IN THE HIGH DOSE RATE RADIOLYSIS OF CO–O_2 MIXTURES. Willis, C.; Boyd, A. W.; Bindner, P. E. (Chalk River Nuclear Labs., Ont.). Can. J. Chem.; 50: No. 21, 3508-3514(1 Nov 1972).

Carbon dioxide and ozone yields were measured in the irradiation of CO–O_2 mixtures with single pulses of electrons. The yields of CO_2 at 2×10^{27} eV g^{-1} s^{-1} are large; $G(CO_2) = 15 \pm 1$ from 20 to 60% O_2. These decrease by ~50% at 10^{28} eV g^{-1} s^{-1}. Although the results are somewhat irreproducible, the addition of c-C_4F_8, an electron scavenger, increases these CO_2 yields at both dose rates by up to a factor of 15. They are reduced to $G(CO_2) < 2$ by the addition of positive ion scavengers. These results are consistent with a chain reaction similar to that proposed for low dose rate studies involving O_2^+, CO_2^+, and CO_4^+ as chain carriers. The ozone yields are consistent with a total oxygen atom yield of G(O) = 1.4 in pure CO from neutral processes. (auth)

12742 RADIATION-INDUCED BINDING OF NUCLEIC ACID CONSTITUENTS WITH PROTEIN CONSTITUENTS AND WITH EACH OTHER. Yamamoto, O. (Hiroshima Univ.). Int. J. Radiat. Phys. Chem.; 5: No. 2, 213-229(Mar 1973).

It was confirmed that gamma rays cause bases and the base region of nucleosides and nucleotides to bind with serum albumin. The binding yields of bases with albumin were comparable to the binding yields of aromatic or sulfur-containing amino acids, and the binding yields of bases with RNA were much lower than the binding yields of aromatic or sulfur-containing amino acids with RNA. A yield-diminishing effect of O_2, methanol, or potassium thiocyanate and a yield-raising effect of N_2O were observed in the binding of bases with albumin or RNA. The binding of bases with aromatic or sulfur-containing amino acids was also confirmed by chromatographic studies. In addition a comparison of the binding yields of tryptophan with soluble-RNA, RNA, and DNA was made. (auth)

12743 RADIOCHEMICAL DECOMPOSITION OF LACTOSYL-6-[^{3}H]-CERAMIDE. Mumford, R. A.; Raghvan, S. S.; Rhoads, D. B.; Kanfer, J. N. (Massachusetts General Hospital, Boston). Lipids; 8: No. 4, 238-240(Apr 1973).

Galactosyl-6-[^{3}H]glucosyl ceramide was prepared by the sequential action of galactose oxidase and sodium borohydride-[^{3}H] reduction. A water-soluble radioactive contaminant appeared after a 2 month storage at −4°C. This was identified as lactose-[^{3}H] by both chromatographic and carrier dilution techniques. (auth)

12744 γ-IRRADIATION ENHANCED YIELD IN THE Ag—CATALYZED OXIDATION OF ETHYLENE. The Kinetics of the Irradiation Process. Forzatti, P.; Klimasara, A.; Kuczynski, G. C.; Carberry, J. J. (Univ. of Notre Dame, IN). J. Catal.; 29: No. 1, 169-172(1973).

Previous work revealed (via x ray spectroscopy chemical analyses) and pre-γ-irradiation of supported silver catalysis causes the appearance of surface calcium, with an associated enhancement in the yield of ethylene oxide in the oxidation of ethylene. Yield enhancement is now reported as a function of time of γ-irradiation. Analysis of these data suggests a tentative model of Ca ejection from inclusions within the Ag crystallites. The experimental rate coefficient for this heretofore unobserved Ca ejection event is extracted to yield the cross-sectional area of the process. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 12606 and 14061.

Hot-Atom Chemistry

12745 ENERGY-DEPENDENT CROSS SECTIONS FOR THE TRITIUM–METHANE HOT ATOM REACTIONS. Valencich, T.; Bunker, D. L. (Univ. of California, Irvine). Chemical Physics Letters; 20: No. 1, 50-52(1 May 1973).

Using classical Monte Carlo trajectory methods, a new kind of empirical potential energy hypersurface was fitted to combined experimental observations on the tritium–methane hot atom reactions. All channels (including Walden inversion) are not present and the degree of uniqueness is apparently high. Predicted cross sections as a function of tritium energy for the abstraction, inverting substituting, and total substitution reactions are presented. (auth)

12746 MECHANISTIC IMPLICATIONS FROM THE SUBSTITUTION REACTIONS WITH METHYL FLUORIDE OF PHOTOCHEMICALLY PRODUCED HOT TRITIUM ATOMS. Chou, C. C.; Wilkey, D. D.; Rowland, F. S. (Univ. of California, Irvine). Chemical Physics Letters; 20: No. 1, 53-58(1 May 1973).

The reactions with CH_3F of photochemically produced tritium atoms from TBr were studied at various wavelengths. The energy threshold is lower and the relative yield higher for F replacement than for H replacement in CH_3F. These near-threshold substitution reactions are consistent with an inversion mechanism. (auth)

12747 CHEMICAL EFFECTS OF OSMIUM NEUTRON CAPTURE RECOILS. Part IV. Effect of Radiation Dose on Retention in Potassium Cyanooesmate(II). Diefallah, E. M. (Assiut Univ., Egypt); Kay, J. G. Indian J. Chem.; 10: No. 12, 1187-1188(Dec 1972).

The effect of neutron and concomitant γ radiation dose was studied in crystals of pure potassium cyanoösmate(II). There is an initially constant value for retention followed by a decrease with increasing radiation dose. (auth)

12748 ^{129}I MOESSBAUER STUDY OF NOVEL POLYHALOGEN IONS FORMED BY RADIOACTIVE DECAY IN THE TELLURIUM HALIDES. Johnstone, J. J.; Jones, C. H. W.; Vasudev, P. (Simon Fraser Univ., Burnaby, B. C.). Can. J. Chem.; 50: No. 18, 3037-3045(15 Sep 1972).

The ^{129}I Moessbauer emission spectra of the compounds $(NH_4)_2$-$^{129m}TeX_6$ and $^{129m}TeX_4$ (X = Cl, Br, I) were measured with a $Na^{129}I$ absorber at 4°K. The spectra give evidence in the case of the $(NH_4)_2TeX_6$ compounds for the formation in the radioactive decay of the octahedral ions ICl_6^-, IBr_6^-, and II_6^-. In the TeX_4 compounds, the emission spectra are much more complex and indicate that the ^{129}I atoms are not found in an environment iso-structural and iso-electronic with that of the parent. The ^{125}Te Moessbauer absorption spectra of the parent compounds were studied to aid in their identification, and the parameters obtained are compared with those in the literature. The ^{125}Te isomer shifts for the TeX_6^{2-} anions are interpreted in terms of pure p-bonding and, in conjunction with data from the emission spectra and data from previously reported n.q.r. work, an isomer shift vs p-hole density relationship is established for tellurium. (auth)

Properties of Radioactive Materials

Refer also to abstracts 12692 and 12693.

12749 (COO-1182-36) RESEARCH IN HIGH TEMPERATURE PHYSICAL CHEMISTRY. Technical Progress Report, May 15, 1971–May 14, 1972 and Final Report. Cater, E. D. (Iowa Univ., Iowa City. Dept. of Chemistry). 11 Jun 1973. 33p. Dep. NTIS $3.75.

Investigations of transition metal, lanthanide, and actinide sulfides and oxides were carried out by five experimental approaches. (1) X-ray diffraction studies at room temperature yielded lattice parameters and phase relationships for the solid phases ScS, YS, LaS, La_3S_4, PrS, Pr_3S_4, GdS, ZrS, US, UO_2, UOS, and their solid solutions. Equilibria between US, UO_2, and UOS were studied at 1000 to 1500°C by a high-temperature diffractometer. (2) Vaporization studies by mass effusion and mass spectrometric techniques yielded enthalpies and entropies of formation of the above solid phases, heats of sublimation, and dissociation energies of the molecules ScS, YS, LaS, PrS, GdS, ZrS, US, UO, PrO, and UOS. (3) Matrix isolation spectroscopy was used to determine vibrational frequencies and force constants for the molecules UO and UO_2. (4) High temperature solid state galvanic cells were used to measure the oxygen potentials of US–UOS–UO_2 mixtures and other metal–oxygen systems. (5) The techniques of electron microscopy and electron diffraction were applied to mixed oxides of Ti, Ba, and Mg to investigate superlattice ordering in tunnel type structures. (auth)

12750 (GAT-P-58/Thesis) AN OPTIMIZATION TECHNIQUE USED TO IMPROVE OPERATION OF A URANIUM–FLUORINE REACTION TOWER. Doman, J. W. (Goodyear Atomic Corp., Piketon, Ohio). 9 Jun 1973. Contract AT(33-2)-1. 64p. Dep. NTIS $5.25.

Thesis.

An investigation was made to minimize costs associated with down-time of a reactor tower, specifically the process involving fluorine–uranium oxide reaction tower used to produce gaseous uranium hexafluoride. A means of readily setting up optimum operation was developed as well as a means of "double checking" for correct operation. (DHM)

12751 SPECIFIC ACTIVITIES OF RADIOACTIVE ELEMENTS FROM FISSION PRODUCT MIXTURES. Koda, Y. (Government Industrial Research Inst., Nagoya, Japan). J. Radioanal. Chem.; 13: No. 1, 255-265(Jan 1973).

Specific activities of radioactive elements at the time of chemical separation from fission product mixtures produced by thermal neutron fission of ^{235}U were computed by Bateman's and other equations on an electronic computer. Computations were made for two fission times: fission was assumed to be complete in a few minutes in one case, and over a period of a year in the other case. It was also assumed that each element was separated instantly after allowing the fission products to decay for 1 to 10,000,000 hrs (1,140 years). The computations were applied to 12 important elements: Ru, Zr, Nb, Cs, Sr, Pm, Tc, Ba, La, Ce, Kr and Y. Results are given as a diagram for each element. The diagrams are intended to be helpful in the chemical processing of a large quantity of fission products, and industrial or tracer application of these elements. (auth)

12752 VOLATILIZATION OF FISSION PRODUCT IODINE FROM SOLID UCl_4. Niedhart, B.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). J. Radioanal. Chem.; 13: No. 1, 53-58(Jan 1973).

It is possible to volatilize about 95% (at temperatures between 200°C and 600°C) of the iodine, which has been produced by irradiating solid UCl_4 with thermal neutrons. The delay times for iodine are decreasing from 2 hrs (at 200°C) to 7 sec (at 600°C). The release of the iodine is improved by using an inert carrier gas. When adding AgCl to the UCl_4 before irradiation is carried out, the release of iodine is suppressed at temperatures lower than 400°C. The adding of KI leads to a more rapid release of iodine at low temperatures. (auth)

12753 NEPTUNIUM(IV) FLUORIDE–THALLIUM(I) FLUORIDE SYSTEM. Jove, J.; Pages, M.; Freundlich, W. (Inst. of Radium, Paris). Radiochem. Radioanal. Lett.; 14: No. 2, 77-86(15 Jun 1973). (In French).

The establishment of solid-liquid equilibrium diagram for the system NpF_4–TlF, coupled with solid state studies by x-ray diffraction, has led to the discovery of seven new phases of tetravalent neptunium. Four of them were identified. (auth)

12754 REACTION OF THE ISOMERIC TRANSITION-ACTIVATED ^{82}Br IN THE $H^{82m}Br$–CH_4 SYSTEM. Yagi, M.; Kondo, K.; Kobayashi, T. (Tohoku Univ., Sendai). Radiochem. Radioanal. Lett.; 14: No. 2, 123-129(15 Jun 1973).

The effect of krypton additive on the reactions of isomeric transition-activated ^{82}Br in the $H^{82m}Br$–CH_4 system was investigated. Both $CH_3{}^{82}Br$ and $CH_2{}^{82}BrBr$ yields gave almost constant values at additive concentration below 0.7 mole fraction. The yield in $CH_2{}^{82}Br$ increased when the mole fraction of the additive exceeded 0.7. These facts strongly suggest the formation of these products via thermal ionic reactions. (auth)

12755 PREPARATION OF FLUORINE-18 LABELLED COMPOUNDS USING A RECIRCULATORY NEON TARGET. Clark, J. C.; Goulding, R. W.; Roman, M.; Palmer, A. J. (Hammersmith Hospital, London). Radiochem. Radioanal. Lett.; 14: No. 2, 101-108(15 Jun 1973).

A method for the preparation of ^{18}F labeled metal fluorides and organic diazonium tetrafluoroborates is described. ^{18}F is produced using a dynamic neon gas target system. The compound to be labeled is supported on a glass fibre filter paper which is mounted in the gas stream externally to the target vessel. The greatly improved specific activities of the product amino acids which may be obtained using this system are due to two factors. Firstly very much smaller starting amounts of the diazonium tetrafluoroborate may be used compared with previously reported methods. Secondly, the times required for chemistry following irradiation were substantially reduced. (auth)

12756 ATTEMPT FOR THE ELECTROCHEMICAL OXIDATION OF CURIUM(III) IN PHOSPHORIC ACID SOLUTION. Myasoedov, B. F.; Lebedev, I. A.; Mikhailov, V. M.; Frenkel, V. Ya. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 14: No. 2, 131-134(15 Jun 1973).

Electrochemical oxidation of Cm(III) was carried out in 15 to

19M H_3PO_4 at a ~2.5 V potential. The absorption spectra of the solutions before and after electrolysis have shown that under these conditions the oxidation of curium did not occur. (auth)

12757 MEASUREMENT OF THE PARTIAL PRESSURE OF A ^{14}C LABELED HYDROCARBON BY MEANS OF A CaF_2(Eu) DETECTOR IN A HIGH VACUUM APPARATUS. Candy, J. P.; Fouilloux, P.; Bussiere, P. (Institut de Recherches sur la Catalyse, Villeurbanne, France). Radiochem. Radioanal. Lett.; 14: No. 2, 145-154(15 Jun 1973). (In French).

An apparatus is described for the continuous measurement of the partial pressures of labeled hydrocarbons. The gas phase is in direct contact with the detector which consists of a single crystal CaF_2 (Eu) disc for scintillation counting. The standardization is made for ^{14}C labeled benzene and shows a direct proportionality between counting rates and pressures up to 10 Torr and equally in a mixture with hydrogen where the hydrogen pressure is less than 100 Torr. The detection cell is chemically inert and can be used under UHV. The associated electronics are simple which makes the whole apparatus very robust, reliable, and easy to use. (auth)

12758 PREDICTION OF THE PROPERTIES AND OCCURRENCE OF ELEMENT 114. Hoffmann, P.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). Radiochem. Radioanal. Lett.; 14: No. 3, 207-215(30 Jun 1973). (In German).

Using an extrapolation method the boiling point (950 to 1200°C), the heat of vaporization (23 to 29 kcal/mole) and the entropy of vaporization (18.7 to 21.2 cal/mole deg) of element 114 were determined. Due to these results the geochemical behavior and the enrichment or depletion respectively in technical processes are discussed. (auth)

12759 PREDICTED PROPERTIES OF THE SUPERHEAVY ELEMENTS. II. Element 111, Eka-Gold. Keller, O. L. Jr. (Oak Ridge National Lab., TN); Nestor, C. W. Jr.; Carlson, T. A.; Fricke, B. J. Phys. Chem.; 77: No. 14, 1806-1809(5 Jul 1973).

The chemical properties of element 111, eka-gold, are predicted through the use of the periodic table, relativistic Hartree–Fock–Slater calculations, and various qualitative theories which have established their usefulness in understanding and correlating properties of molecules. The results indicate that element 111 will be like Au(III) in its chemistry with little or no tendency to show stability in the I or II states. There is a possibility that the 111^- ion, analogous to the auride ion, will be stable. (auth)

12760 CHEMISTRY OF THE TRIVALENT ACTINIDES. Part 3. Some Chemical and Physical Properties of Hydrated Uranium(III) Fluoride and the Anhydrous Chloride, Bromide, and Iodide. The Stability of Uranium(III) in Aqueous Solution and in Organic Solvents. Barnard, R.; Bullock, J. I.; Gellatly, B. J.; Larkworthy, L. F. (Surrey Univ., Guildford, Eng.). J. Chem. Soc., Dalton Trans.; No. 6, 604-607(1973).

The halides UX_3 (X = Cl, Br, or I) were prepared and their electronic spectra measured at room and liquid nitrogen temperatures. The interactions of the halides with a large number of organic solvents are given. Hydrated uranium(III) fluoride, UF_3H_2O, and a carbonate and hydroxide of uncertain compositions were recognized. The extreme reactivity of uranium(III) to most anions and organic solvents in which it is soluble severely limits the chemistry of this oxidation state even if oxygen is rigorously excluded. (auth)

12761 POLARIZED LUMINESCENCE SPECTRUM OF CRYSTAL OF RUBIDIUM URANYL NITRATE AT LIQUID-HELIUM TEMPERATURE. Komyak, A. I.; Sleptsov, S. E.; Vitkovskii, G. P. Zh. Prikl. Spektrosk.; 18: No. 3, 410-415(Mar 1973). (In Russian).

A luminescence spectrum of a crystal of $RbUO_2(NO_3)_3$ was made at the temperature of liquid He. The line splitting observed was interpreted with the help of polarization measurements and an evaluation of relative intensities. Observed triplets were associated with the emanation of a combination of vibrations of the crystalline lattice with all of the internal vibrations of the complex $[UO_2(NO_3)_3]^-$. The difference in spectra taken at liquid He and liquid N_2 temperatures is discussed. (tr-auth)

12762 INFRARED SPECTRA OF MATRIX ISOLATED UO AND UO_2. Rooney, T. A. Iowa City, IA; Univ. of Iowa (1972). 116p. University Microfilms Order No. 73-13,587.

Thesis (Ph.D.).

The infrared spectra of the molecules produced by the vaporization of UO_2 at temperatures up to 2500°K were recorded and analyzed. The antisymmetric stretching frequency ν_3 of $U^{16}O_2$ was found to be 775.6 ± 1.0 cm^{-1} when isolated in an argon matrix. The corresponding value for $U^{18}O_2$ is 736.4 ± 1.0 cm^{-1}. The infrared spectrum of the mixed isotope $U^{16}O^{18}O$ was also recorded; the value of ν_3 is 770.6 ± 1.0 cm^{-1} while ν_1 was found to have a value of 728.1 ± 1.0 cm^{-1}. These values for the mixed isotope are shown to agree very well with the values calculated using the assigned frequencies of $U^{16}O_2$ and $U^{18}O_2$. A bond angle of 160° ± 20° was calculated for UO_2 based on the frequency shift between the antisymmetric mode of $U^{16}O_2$ and $U^{18}O_2$. A normal coordinate analysis was performed for UO_2 and the results were used to calculate the relative intensities of $U^{16}O_2$, $U^{16}O^{18}O$, and $U^{18}O_2$ as a function of bond angle. The calculated intensities are shown to agree quite well with the experimental results over a wide range of starting material isotopic compositions. The vibrational frequency of $U^{16}O$ in argon was found to be 819.1 ± 1.0 cm^{-1}; a value of $U^{18}O$ could not be determined because the $U^{18}O$ frequency was shown to lie within 1.0 cm^{-1} of the UO_2 antisymmetric stretching frequency at 775.6 cm^{-1}, by calculation. (Diss. Abstr. Int., B)

Radioactive Waste Treatment

Refer also to abstracts 13399 and 14475.

12763 (AEC-tr-7433) FLOCCULATION AND SEDIMENTATION OF SUSPENDED RADIOACTIVE CONTAMINANTS IN WASTE WATER BY CONTROL OF THE ZETA POTENTIAL. Johannsen, K. H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Translated from report SZS-3/71, pp 2-19. 15p. Dep. NTIS.

The decontamination of waste water from nuclear plants was performed by coagulation with aluminum sulfate and flocculation with organic polymers of the STIPIX series controlling the zeta potential according to RIDDICK. The zeta potential, the sinking speed of the flocs, and the residual turbidity were determined in dependence on the pH value and the quantity of flocculating agent. The results are discussed, and the usefulness of controlling the flocculation by measuring the zeta potential is critically evaluated. (auth)

12764 (AEC-tr-7434) RADIOACTIVE WASTES FROM REPROCESSING OF IRRADIATED FAST REACTOR FUELS. Sachse, G.; Anders, G. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Translated from report SZS-3/71, pp 20-32. 11p. Dep. NTIS.

Some specific aspects of radioactive wastes arising from the reprocessing of fuel elements of fast reactors are discussed. In addition to the waste solutions originating from aqueous reprocessing, emphasis is given to the gaseous and solid wastes of non-aqueous processes. Because of the high residual heat the highly radioactive wastes of the fluorinating reprocessing must be stored with cooling for at least two years. Thereafter they are incorporated into melted silicates to assure safe storage. Finally, developments of appropriate processes are described and problems of the ultimate storage of high-activity vitreous blocks are considered. (auth)

12765 (GEPP-104) TRITIUM CONTROL TECHNOLOGY. Ward, W. E. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). 16 Jul 1973. Contract AT(29-2)-656. 25p. Dep. NTIS $3.25.

To protect personnel and the environment against radioactivity, control technology was developed for a plant using tritium. Details for monitoring, containing, trapping, and disposal are discussed. Monitoring is done of room air, stack effluents, liquid effluents, and water. Exhaust hoods, shrouds, and gloveboxes are used for containment and handling. A stack effluent control system removes tritium gas discharged from vacuum pumps. Wastes are sealed in DOT approved drums and shipped to an AEC burial ground. (auth)

12766 (ICP-1022, pp 50-87) WASTE MANAGEMENT. Apr 1973.

In Idaho Chemical Programs annual technical report, fiscal year 1972.

Operating experience in the Idaho Waste Calcining Facility (WCF) is reported. Progress in the following support studies for WCF operations is discussed: pilot plant studies on in-bed combustion nozzles; effect of boron on complexing of zirconium fluoride wastes with calcium nitrate; DTA examination of stainless steel–nitric acid wastes; calcination of stainless steel sulfate wastes; DTA studies in support of calcination of Na- and K-containing wastes; calcination of second-cycle wastes using sulfate addition; calcination of second-cycle wastes by the cryolite process; calcination of H_2SO_4-neutralized Purex waste; corrosion in pilot-plant calciners; Ru volatility from WCF waste solutions; and, evaluation of WCF silica gel. The compaction of WCF calcine and the effects of calcine properties on future storage bin designs were studied. The following studies dealing with liquid-waste management activities are reported: stability of stainless steel sulfate and aluminum nitrate waste blends and the corrosion of buried waste lines. In the management of gaseous wastes the following studies are reported: evaluation of ICPP stack monitor; autoradiographing of ICPP stack monitor filters; improved off-gas

cleanup systems; atmospheric protection system for filtration of ventilation air and off-gas streams; and evaluation of off-gas prefilter medium. Tests were conducted on solid waste retrieval at the National Reactor Testing Station (NRTS) Burial Ground in order to gain insight into problems that might arise in a large-scale exhuming operation. (JGB)

12767 (RFP-2016) FLUID BED INCINERATION. Ziegler, D. L.; Johnson, A. J.; Meile, L. J. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 8 Jun 1973. Contract AT(29-1)-1106. 13p. Dep. NTIS $4.00.

A fluid bed incineration process was tested on a laboratory scale for combustion of typical, plant-waste material. Sodium carbonate bed material is used for the in situ neutralization of the hydrogen chloride generated by the large amounts of poly-(vinyl chloride) burned. Waste preparation and an evaluation of catalytic afterburning of reactor off-gases are included. (auth)

12768 CRYOGENIC APPROACH TO FUEL REPROCESSING GASEOUS RADWASTE TREATMENT. Davis, J. S.; Martin, J. R. (Union Carbide Corp., Tonawanda, NY). Trans. Amer. Nucl. Soc.; 16: 176-177(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12769 FOAM SEPARATION METHODS. Somasundaran, P. (Columbia Univ., New York). Separ. Purif. Methods; 1: No. 1, 117-198(1972).

An overview of various foam separation techniques—foam fractionation, ion flotation, foam flotation, microflotation, precipitate flotation and, particularly, froth flotation—based on preferential concentration at the liquid/gas interface of detergents, proteins, microorganisms, minerals, and surfactant-ion complexes containing, for example, such radioactive impurities as radium and strontium or such inorganic wastes as dichromate, phosphate and lead is presented. Recent theoretical and developmental work in the area is summarized. The relationship between adsorption at various interfaces and froth flotation of minerals is examined along with a brief analysis of the physical principles involved. Finally, a discussion of various foaming devices and a summary of reported applications of the techniques are given. (auth)

12770 DECONTAMINATION OF RADIOACTIVELY CONTAMINATED WATER USING PEAT FILTERS. Bezzegh-Galantai, M. M. Diss. Nr. 4376. Zurich; Eidgenoessische Technische Hochschule (1970). 46p. (In German).

Thesis.

Experiments were carried out with the objective to determine the decontamination of rain and model water containing $^{90}Sr-^{90}Y$, ^{131}I by various peats. The chemical composition of the model water was similar to rain, cistern water. Peat samples were taken in the Jura mountains, Neuchâtel region, Switzerland. Percolation experiments were carried out in laboratory ion-exchange columns of the usual dimensions and in pilot scale installations to determine the decontamination capacity of three types of peat. Good decontamination effects were determined for $^{90}Sr-^{90}Y$. The main parameters influencing the breakthrough capacity are: Type of peat, degree of drying and deep freezing. In addition, other factors particularly those with regard to exchange capacity are also significant. A measurable retention of anionically available ^{131}I was observed at extremely low concentrations only ($<10^{-9}$ Mol NaI/liter). Retention increases exponentially with increasing dilution ratios. A solution of $<10^{-12}$ Mol $Na^{131}I$/liter showed a retained activity of 60 to 90% related to the inflowing solution. The experiments yielded useful findings with regard to soil science. Particularly interesting are the irreversible structure changes of peat due to deep freezing and drying, and the correlation between calcium content or degree of decomposition and exchange or breakthrough capacity for cations. (auth)

12771 LINEAR PROGRAMMING APPROACH TO SCHEDULING NUCLEAR ISOTOPE PRODUCTION. Moore, J. R. Jr. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Eng. Manage.; 20: No. 2, 51-55(May 1973).

The design, implementation, and use of a model for scheduling the production of nuclear isotopes is presented. The model is formulated as a multiple-period linear-programming (LP) problem with several classes of product-demand, inventory, and production-level constraints. An important feature of the model is its role in managing in-process inventories over the extended period of time required for the production of certain isotopes. Considerable discussion is given to practical issues surrounding the model implementation and the model's many production and marketing applications. (auth)

Radioisotope Production

Refer also to abstracts 12682 and 12683.

12772 (SUNI-23, pp 35-37) PRODUCTION OF CARBON-11 IN THE FORM OF CO AND CO_2. Pretorius, R.; Bain, C. A. R.; Peisach, M.; Kritzinger, J. J.; Verbruggen, R.; Schmitt, H. 1972.

12773 APPLICATION OF AMBERLITE XE-270 RESIN TO PURIFICATION OF NEPTUNIUM. Schultz, W. W. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 175-176(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12774 PRELIMINARY STUDY OF QUALITY CONTROL OF ^{99m}Tc FROM ^{99}Mo GENERATORS. Oniciu, L.; Cook, G. B. (International Atomic Energy Agency, Siebersdorf, Austria). J. Radioanal. Chem.; 13: No. 1, 247-254(Jan 1973).

The separation of Tc(VIII) from Mo(VI) by thin-layer and paper chromatography is discussed. Some aspects concerning the formation and identification of lower oxidation states of Tc(VII) are also mentioned. Finally, a spot test is recommended for the determination of Mo(VI) and Al, which can be contaminants in the Tc(VII) solution eluted from the ^{99}Mo column, filled with Al_2O_3. (auth)

12775 HISTORY OF THE SYNTHESIS OF ELEMENTS 102, 103, 104, AND 105. Mekhtieva, A. R. (Azerbaydzhan State Univ., Baku). Azerb. Khim. Zh.; No. 3, 160-163(1972). (In Russian).

Beginning with Nobelium, element No. 102, the history of the discovery of the four newest elements is briefly reviewed. Proposed names for Nos. 103-105 are Lawrencium (Lr), Kurchatovium (Ku), and Nielsbohrium (Bo). 16 references. (KSW)

12776 RECOVERY OF FISSION PRODUCT ZIRCONIUM FROM PUREX WASTE SLUDGE. Kelley, J. A. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. Radiochem. Radioanal. Lett.; 14: No. 2, 95-100(15 Jun 1973).

Three hundred milligrams of fission product zirconium was recovered by leaching zirconium from aged Purex waste sludge, adsorption of zirconium onto manganese dioxide, and separation by cation exchange chromatography. The purified zirconium ~19% ^{93}Zr, was essentially free of other radionuclides. (auth)

12777 PRODUCTION OF ACTINIDES AND USEFULLY RELEVANT FISSION PRODUCTS FROM WASTE SOLUTIONS OF IRRADIATED NUCLEAR FUELS BY COUNTERCURRENT ION MIGRATION. Bilal, B. A.; Schwarz, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Radiochim. Acta; 18: No. 3, 148-150 (1972). (In German).

A study is reported on reprocessing of the waste solution of spent nuclear fuels by means of countercurrent ion migration; it was conducted on a model mixture. The actinide elements Np, Am, and Cm and the fission products relevant for application were obtained in a relatively simple separation process. (auth)

12778 SEPARATION OF ^{238}Pu AND ^{242}Pu FROM IRRADIATED ^{241}Am. Watanabe, K.; Sagawa, C.; Ueno, K. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 1, 62-63(Jan 1973).

Mixed oxide pellets of $^{241}AmO_2$ and MgO were irradiated in the JRR-2. The resulting plutonium was extracted, and the ratio $^{242}Pu/^{238}Pu$ was measured. The $^{242}Pu/^{238}Pu$ ratio vs cooling period is shown. (LTW)

12779 NOTE ON THE PRODUCTION OF ^{123}I FOR RADIODIAGNOSTICAL PURPOSES. Deglume, C.; Deutsch, J. P.; Favart, D.; Prieels, R. (Univ., Louvain, Belg.). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 291-293(May 1973).

The advantages of ^{123}I for radiodiagnostic purposes can be reduced by the presence of other isotopes which are produced simultaneously. For a given reaction a compromise has to be found between the yield of the ^{123}I and the harmfulness of the parasitic activities. The expected yield, the relative toxicity from parasitic activities and the price and technical intricacy of different nuclear reactions potentially suitable for ^{123}I production have been considered and the three most suitable are discussed in detail. Of these the simplest and cheapest reaction appeared to be $Sb_{nat}(\alpha,2n)^{123}I$; the radiotoxicity of the parasitic activity produced stays moderate compared to that of ^{131}I if the product can be used rather quickly after the end of the irradiation. If a very low radiotoxicity is required, the use of isotopically enriched targets more expensive and technically more intricate should be considered: $^{121}Sb(\alpha,2n)^{123}I$ or, possibly, the reaction $^{124}Te(p,2n)^{123}I$ which seems very promising but has not been tested experimentally as yet. (UK)

12780 PRODUCTION OF ^{67}Ga BY DEUTERON BOMBARDMENT OF NATURAL ZINC. Steyn, J.; Meyer, B. R. (National Physical Research Lab., Pretoria). Int. J. Appl. Radiat. Isotop.; 24: No. 7, 369-372(Jul 1973).

Excitation functions were determined by the "stacked-foils"

method for the concurrent production of ^{67}Ga and ^{66}Ga by the bombardment of natural zinc with deuterons in the energy range 0 to 16 MeV. The measured thin-target yield for the production of ^{67}Ga reached a maximum of 1.93 $\mu Ci/\mu Ah$ per mg/cm^2 at 9 MeV. Thick-target yields were calculated as functions of energy; the calculated production rates of ^{67}Ga and ^{66}Ga by bombardment of natural zinc with 16 MeV deuterons were 352 $\mu Ci/\mu Ah$ and 1489 $\mu Ci/\mu Ah$, respectively. Regular commercial production of ^{67}Ga for medical application is briefly described. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 12854, 14423, and 15003.

12781 (ICP-1016) DEVELOPMENT OF PROCESSES AND EQUIPMENT FOR RECOVERING URANIUM FROM ROVER-FUELS-BURNER ASH. Hogg, G. W.; Rindfleisch, J. A.; LaMont, P. E.; Borduin, L. C.; Lohman, G. W.; Fox, M. R. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). May 1973. Contract AT(10-1)-1375. 58p. Dep. NTIS $5.45.

Development of processes and equipment for recovering uranium from nuclear rocket (Rover) fuels is described. Secondary burning of primary ash, ash dissolution, liquid-solids separation, startup and supplemental heating of fluidized-bed burners, and other related development areas are discussed. Recovery of greater than 99.8% of the uranium from the ash was demonstrated in the pilot plant. (auth)

12782 (ICP-1022) IDAHO CHEMICAL PROGRAMS ANNUAL TECHNICAL REPORT, FISCAL YEAR 1972. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Apr 1973. Contract AT(10-1)-1375. 118p. Dep. NTIS $5.45.

Research progress is reported in fuel reprocessing, waste management, and other chemical programs activities. Individual abstracts have been prepared for each of the three categories. (JGB)

For abstracts of individual sections see: 12766, 12783, and 12784.

12783 (ICP-1022, pp 1-49) FUEL REPROCESSING. Apr 1973.

In Idaho Chemical Programs annual technical report, fiscal year 1972.

Results of studies on the performance of ICPP fuel recovery processes are reported in discussions of Zr fuel reprocessing, corrosion evaluation of Zr process vessels, custom reprocessing of special fuels, product denitration, recovery and purification of ^{237}Np, and corrosion evaluation of fixed nuclear poisons. The following support studies for current ICPP fuel recovery processes are evaluated: extraction system studies, product UO_3 studies, equipment and utilities, and safeguards program. The following studies dealing with the electrolytic dissolution project are reported: soluble nuclear poison detection system, spontaneous dissolution of uranium metal during power interruption, radiation fields from electrolytic dissolution solids, characterization of stainless steel electrolytic dissolver solids, use of filters for removal of stainless steel fines from electrolytic dissolver product, and electrolytic-dissolver product extraction data. The following graphite fuels processing studies are reported: graphite fuels pilot plant studies, secondary burner studies, and off-gas cleanup and decontamination. In additional studies, efforts were made to locate leaking fuel elements in the ICPP basin. Several ion-exchange materials were tested for possible use in a unit to be installed at the fuel storage basin. The feasibility of steam-fluidized-bed denitration of uranyl nitrate hexahydrate (UNH) solutions was demonstrated. (JGB)

12784 (ICP-1022, pp 88-114) OTHER CHEMICAL PROGRAMS ACTIVITIES. Apr 1973.

In Idaho Chemical Programs annual technical report, fiscal year 1972.

Progress is reported on burnup methodology for fast reactor fuels. Two irradiations were conducted in the EBR-II, and neutron spectra measurements made on the fission yields. Capture-to-fission ratios and breeding potentials for EBR-II and Fast Test Reactor (FTR) capsules are compared. Neutron energies for FTR, 1000 MWe LMFBR, and EBR-II unshielded irradiation assembly are tabulated. Studies on the evaluation of silver-exchanged zeolites for the removal of airborne iodine species encountered in the nuclear industry are reported. The cation-exchanged Y-type zeolites were found to perform better than the X-type zeolites in the adsorption of methyl iodide. Decontamination factors for various adsorbents as a function of methyl iodide concentration and bed depth are tabulated. The use of metal-exchanged zeolites as catalytic materials for the reduction of corrosive nitrogen oxides by NH_3, CO, and H_2 was studied. In connection with desalination studies, the initial technical feasibility of brine disposal using fluid-bed evaporation was established from small-scale experimental work and preliminary process design and cost estimates. (JGB)

12785 (ICP-1024) CO-PROCESSING OF ZIRCONIUM AND ALUMINUM FUELS DURING 1972. Henry, R. N.; Bendixsen, C. L.; Bradley, R. D. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). May 1973. Contract AT(10-1)-1375. 41p. Dep. NTIS $4.00.

The second co-processing campaign at the Idaho Chemical Processing Plant (ICPP) was conducted during 1972. Zirconium and aluminum fuels containing highly enriched uranium were dissolved in separate dissolvers and the dissolver products were blended together to form the feed to the solvent extraction system. Improvements over previous campaigns in processing rates and uranium recovery were realized. The use of gadolinium as a soluble nuclear poison and the importance of feed clarification for the extraction system were again demonstrated. Operation of a new air-pulser system for the first cycle extraction columns was trouble free and promoted improved column performance. Prior to this campaign, areas of the dissolver vessel located above the normal operating liquid level were successfully repaired in a unique manner. (auth)

12786 GAS CHROMATOGRAPHIC DETERMINATION OF THE DECOMPOSITION PRODUCTS OF TRIBUTYL PHOSPHATE. Brignocchi, A.; Gasparini, G. M. (CNEN-CSN, Rome). Anal. Lett.; 6: No. 6, 523-530(1973).

The products formed from tributyl phosphate in different diluents were quantitatively analyzed for components by gas chromatography. Methylation yields and limits of detection of dibutyl phosphate are given. (auth)

12787 PROCESSING OF IRRADIATED NUCLEAR FUEL. Mills, A. L.; Hartley, K. (to United Kingdom Atomic Energy Authority). U. S. Patent 3,714,058. 30 Jan 1973. Priority date 26 Aug 1969, United Kingdom of Great Britain and Northern Ireland (UK). 2p.

Irradiated monocarbide nuclear fuel, which may contain significant plutonium as well as uranium, is converted to oxide by heating in carbon dioxide, preferably at a temperature of 1000°C. Sesquicarbide may also be present. The product is dioxide soluble in nitric acid. (Official Gazette)

12788 METHOD FOR RECOVERING URANIUM AS URANIUM HEXAFLUORIDE. Massonne, J.; Kreutz, R.; Friedrich, H. (to Kali-Chemie Aktiengesellschaft). U. S. Patent 3,720,748. 13 Mar 1973. Priority date 18 Mar 1968, Federal Republic of Germany (F.R. Germany). 10p.

Uranium is recovered as the hexafluoride from coated or uncoated nuclear fuel by reacting the fuel at a temperature of at least 500°C with a mixture of oxygen and gaseous hydrogen fluoride followed by reaction with elementary fluorine at 500 to 750°C. (Official Gazette)

ENGINEERING

Energy Conversion

Refer also to abstracts 12977, 12978, 12980, 14574, and 14577.

12789 (AI-AEC-13099) NaK LOOP TESTING OF THERMOELECTRIC CONVERTER MODULES. Johnson, J. L. (Atomics International Div., Canoga Park, Calif. (USA)). 21 May 1973. Contract AT(04-3)-701. 38p. (NASA-CR-121192). Dep. NTIS $4.00.

The history of testing of Westinghouse compact tubular modules in flowing NaK loops at Atomics International is summarized. Test procedures, data handling, and instrument calibration are discussed. Also included is descriptive information of the test facilities, operational problems encountered, and some recommendations for testing. (auth)

12790 (SLA-73-5319) ANALYSIS OF LINEAR FOCUSED COLLECTORS FOR SOLAR POWER. Pope, R. B.; Schimmel, W. P. Jr. (Sandia Labs., Albuquerque, N. Mex.). 1972. 7p. (CONF-730811-6). Dep. NTIS $3.00.

The use of linear focused collectors to collect solar energy in a high-quality (high-temperature) state is analytically studied. The effects of variations in concentration, absorptance, and emittance of the receiver, silvering of the envelope, and system geometry are considered. Convective and radiative transport between the receiver and envelope and from the envelope to the environment are modeled. Radiative exchange processes are modeled with an approximate two-wavelength band model. Calculated results are presented for varying values of specular solar input, linear aperture, concentration, absorptance, emittance, collection temperatures, for both silvered and unsilvered envelopes, and for both evacuated and unevacuated cavities. The study indicates that collector extraction efficiencies of 40 to 60% can be reasonably expected. Highly selective surfaces are relatively unimportant for values of X greater than about 30 if the envelope is silvered. Collector efficiency is increased with increasing linear aperture. The studies indicate that efficient focused collectors providing high-quality energy can probably be constructed with available technology. (auth)

12791 QUASI-ONE-DIMENSIONAL THEORY OF THE MHD GENERATOR. Pelz, P. Rozpr. Cesk. Akad. Ved, Rada Tech. Ved.; 81: No. 3, 99(1971). (In Czech).

The operating behavior of the Faraday and Hall MHD generator types is analyzed from the standpoints usually used in studies of electrical machines. A quasi-one-dimensional model of the processes in the machine is used; however, the assumption of integral neutrality of the space charge in the generator channel instead of local space charge neutrality is introduced. This assumption enables the calculation of the space charge density distribution in the channel. Based on the above, the formulas for the calculation of the main electrical operating parameters (particularly the terminal voltages and loading currents) of the basic types of MHD generators are deduced. The results obtained by the use of those formulas may be utilized for further thermodynamic cycle analysis. The studies mentioned are followed by an analysis of the working fluid electrical conductivity and the Hall coefficient influence on the optimum operating conditions of various types of MHD generators. The optimum values of the load, pressure, and magnetic induction for the generator types examined are derived by utilizing the assumptions of inverse proportionality of the conductivity of the second root of the working medium pressure, direct proportionality of the Hall coefficient on the inductivity, and its inverse proportionality on the pressure. (App. Mech. Rev.)

12792 RADIOISOTOPE GENERATOR SOURCE GICODYME 400. Cohn, M. (CEN de Saclay, Gif-sur-Yvette, France); Sauvagnac, R.; Lavigne, P.; Teytu, A.; Cavoret, J. C. Bull. Inform. Sci. Tech. (Paris); No. 177, 3-10(Jan 1973). (In French).

Gicodyne 400 is a radioisotope power supply utilizing ^{60}Co and delivers 110 watts. The conversion of heat into electricity is accomplished using a system provided with two organic liquid vapor turbines which operate in cascade. Each turbine drives an alternator. The operational safety of the system was given particular attention. The thermal parameters of the system were accurately measured. (FR)

12793 UNSTEADY MHD DUCT FLOW BY THE FINITE ELEMENT METHOD. Wu, S. T. (Univ. of Alabama, Huntsville). 6: 3-10(1973).

The application of the finite element method to obtain an approximate numerical solution to a class of unsteady magnetohydrodynamic flow in ducts with arbitrary cross-section is described. A consistent discrete model for the MHD flow equation with a small magnetic Reynolds number was developed via the concept of finite elements. A numerical example of MHD flow in a rectangular duct is given, and its results of velocity profiles are compared with the results obtained by other methods. (auth)

12794 MAGNETOHYDRODYNAMIC GENERATORS. IPP Presseinformation, No. 57. (1972). vp. (In German).

From information meeting of the Max-Planck Institute for Plasmaphysics; Garching, Germany (7 Nov 1972).

A short survey is given of the principle of MHD power generation and of the research activities in this field in the Federal Republic of Germany. The short-time operating open-channel MHD generator developed at Garching is described. This device uses kerosene and liquid oxygen (seeded with potassium). Economic implications are also noted. (GE)

12795 MHD FLUCTUATING FLOW IN SLIP-FLOW REGIME WITH VARIABLE SUCTION. Soundalgekar, V. M. Mat. Vesn. Nova Ser.; 8: No. 23, 187-197(1971).

An analysis of two-dimensional incompressible electrically conducting flow over a porous wall in the rarefied slip flow regime is presented. A constant magnetic field is applied normal to both the mean flow direction and the porous wall. Small sinusoidal oscillations are assumed in both the mean flow and the mean suction velocity; these have the same frequency. This work assumes prior knowledge of nonmagnetic solutions and approximate magnetic solutions without slip flow in order to study simultaneously variable suction velocity and first-order slip-velocity boundary conditions in the magnetic case. Induced magnetic fields are also included. Results are plotted for velocity fluctuation, induced fields, and current; skin friction is tabulated. It is concluded that magnetic field helps suppress flow separation and that increasing frequency increases skin friction, and that suction first increases friction, then reduces it. (Applied Mechanics Reviews)

12796 EXPERIMENTS ON MHD GENERATORS WITH NONEQUILIBRIUM IONIZATION USING POTASSIUM-SEEDED ARGON PLASMA. Shirakata, H.; Takashashi, K.; Hiramoto, T.; Yano, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 1, 10-21(Jan 1973).

The results of a series of experiments aimed at the realization of nonequilibrium ionization in generators using magnetically induced ionization are described. The experiments were performed with two Faraday-type MHD generators using potassium-seeded argon plasma in the temperature range of 1600 to 2000°K at about 1 atm. In the first experiment, the mechanical and the thermal performances of the generator channel and also its electrical characteristics were observed in quasi-equilibrium state, the results of which indicated satisfactory operation. In the second experiment, the electrical characteristics of the generator with an improved configuration were measured. The experimental results were explained with use made of the four-terminal network theory which involves the nonequilibrium ionization and instability effects, and the experimental results agreed well with theory. Despite the small experimental scale, an increase in power output by magnetically induced ionization was successfully achieved with good reproducibility when preionization was suitably applied. (auth)

12797 POSSIBILITY OF AN APPROXIMATE PARAMETRIC EVALUATION OF THE BEHAVIOR OF A MHD GENERATOR. Coghe, A.; Ghezzi, U. (Istituto di Macchine, Milan). Termotecnica (Milan); 27: No. 4, 210-213(Apr 1973). (In Italian).

A method for studying the wide variability fields of MHD generator parameters or to give the main elements to evaluate the efficiency of the different configurations is presented. The method involves the establishment of the total enthalpic difference between the inlet and outlet sections of the duct and in this way determining the main parameters at the outlet. Using this method. it is possible to make an approximate evaluation of the performance of the MHD duct. (auth)

12798 NONEQUILIBRIUM IONIZATION IN MHD CONVERTER GENERATORS. Caressa, J. P. (Univ., Marseille). Compt. Rend., Ser. A, B; 276: No. 12, 883-886(19 Mar 1973). (In French).

It is shown possible to explain the smallness of the electrostatic Hall field observed in experimental MHD converters in terms of nonequilibrium ionization without involving the generally used ionization instability mechanisms. (FR)

12799 COBALT-60 RADIOISOTOPE-FUELED POWER PACKAGE FOR UNDERSEA APPLICATIONS. Macdonald, A. G.; Kast-

ner, G. A. (Marine Development Group Ltd., Toronto). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 27-32(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Facilities and Equipment

Refer also to abstracts 12840, 14656, 15174, and 15175.

12800 (CONF-721089-3) ERRORS IN STRESS DUE TO ERRORS IN STRAIN GAGE READINGS. Nolan, D. J. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). 1972. 3p. ISA.

From Instrument Society of America and Exhibit Conference; New York, New York, USA (9 Oct 1972).

Electrical resistance strain gages have errors due to many different factors. The error can be large depending on the conditions to which the gages are subjected. Therefore, stresses calculated from strain gage readings will also have errors. The magnitude of stress error that can result from multi-strain gage installations is studied. This error can be much greater than the error for each individual gage. The stress-strain equations for multi-strain gage installations are well known. From these equations, expressions were derived from which the stress error could be determined for a particular strain error. The error in stress can be considerably larger than the error in strain. In fact, the error in stress can go to infinity. The stress error approaches infinity asymptotically at values of strain ratio of μ and $1/\mu$ (μ = Poisson's ratio). The study was undertaken for the evaluation of the structural performance of a sodium-to-sodium heat exchanger and a sodium-to-water/steam steam generator. (auth)

12801 (EUR-4820(Vol.3)(Pt.E), pp 87-98) IMPACT STRESS WAVES IN COMPOSITE STRUCTURES. Hayashi, T.; Fujimara, Y.; Morisawa, K. (Osaka Univ.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Impact stress waves in a structure composed of two different members were investigated. When a stress wave traveling in a composite structure encounters a discontinuous plane, reflection and transmission occur. The reflected stress waves are found to be obtained by solving an integral equation. Calculations are worked out for a bar attached to a conical body, T shaped structure composed of two bars and a composite structure of a bar and a plate. Theoretical solutions show good accordance with experimental results. (auth)

12802 (EUR-4820(Vol.3)(Pt.E), pp 423-434) USE OF DIGITAL COMPUTERS IN EXPERIMENTAL ANALYSIS OF STRUCTURAL VIBRATIONS. Cimorelli, L. (Progettazioni Meccaniche-Nucleari S.p.A., Genoa). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Referring to the specific field of structural vibrations, a general survey is made of methods employed in computation of statistical functions from experimental data. Analog and hybrid methods are gradually replaced by digital data processing. General background of digital methods is presented. Statistical functions to be computed and computational difficulties are illustrated, referring to time series generated from continuous analog data. Many different practical solutions, referring to computer's dimensions and user's needs, are described; accent is placed on man-machine interaction. (auth)

12803 (SLA-73-508) EXPERIMENTAL-THEORETICAL CORRELATION ON THE CONTAINMENT OF EXPLOSIONS IN CLOSED CYLINDRICAL VESSELS. Benham, R. A.; Duffey, T. A. (Sandia Labs., Albuquerque, N. Mex.). Jun 1973. 31p. Dep. NTIS $3.75.

Containment design formulas are developed for prediction of the maximum wall deformation of a cylindrical vessel due to detonation of a centrally located bare spherical high-explosive charge. Vessel wall response due to both the initial impulse loading and the long-term pressure buildup is considered. Formulas, which incorporate a rigid-plastic material model including strain hardening and strain rate sensitivity, are written in terms of elementary functions suitable for containment design calculations. Wall response predictions compare favorably with the results of an experimental program performed in mild steel containment vessels closed with massive end caps. (auth)

12804 (TID-26324) REPORT ON CURRENT STANDARDS FOR AIR-COOLED HEAT EXCHANGERS. Rossie, J. P. (Beck (R. W.) and Associates, Denver, Colo. (USA)). May 1973. Contract AT(04-3)-848. 112p. GPO.

Results of an investigation performed to review the current status of standards for air-cooled heat exchangers in general and to assess the work which has been done on standards for air-cooled heat exchangers as to their suitability and adaptability to large steam-electric plant dry cooling systems are given. (auth)

12805 IMPROVEMENTS IN OR RELATING TO FLUID SAMPLING DEVICES. Spackman, R. (to United Kingdom Atomic Energy Authority). British Patent 1,314,016. 18 Apr 1973. Filed date 4 Jul 1969. 4p.

A fluid sampling device is described for making large-scale flow measurements, such as measuring the flow in rivers, large conduits, and the like, by injecting a radioisotope tracer at a constant rate and withdrawing samples at regular intervals from a downstream position. In cases where the flow is varying, for example in tidal areas, or where mixing is incomplete due to the withdrawal point being too close to the injection point, serious errors can arise in the measured mean flow unless precautions are taken; the best technique is to take a set of samples, each of which is a fixed proportion of the flow, over the whole of the injection period. The design of the sampling device must be such that precise timing of the sample collection is possible and there is no cross-contamination between samples. A full constructional description is given of the device. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 12804, 12884, 12994, 13242, 14308, 14402, 14408, 14429, 14438, 14529, 14587, 14608, 14618, 14619, 14643, 14669, 14672, 14797, and 14821-14824.

12806 (AEEW-R-807) INTERACTION OF DROPLET DEPOSITION AND FORCED CONVECTION IN POST-DRYOUT HEAT TRANSFER AT HIGH SUBCRITICAL PRESSURE. Bailey, N. A. (Atomic Energy Establishment, Winfrith (England)). Mar 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

Experiments were carried out on the high pressure rig at Winfrith on a vertical U-tube test section of 12.8 mm bore and 12.2 m total heated length (L/d = 954). During this test programme a large number of measurements were made of post-dryout heat transfer. For these measurements on post-dryout heat transfer, dryout was established part way up the riser section and the heat flux down-stream of dryout was varied. In this way, for a given dryout heat flux and quality, a variety of downstream conditions could be investigated. The tests were carried out principally at 180 bars at mass velocities from 670 to 2700 kg/m^{2}s and some were repeated at 160 bars to check the effect of reducing pressure. Measurements were made of the wall temperature downstream of dryout, the data was compared with existing correlations and analyzed in an attempt to separate the components of droplet deposition and forced convection in post-dryout heat transfer. (auth)

12807 (CONF-730904-2) CLEANING DISTILLATION PLANT HEAT TRANSFER TUBING. Reed, S. A.; Taylor, L. T. (Oak Ridge National Lab., Tenn.; Office of Saline Water, Washington, D. C.). 1972. 14p. Dep. NTIS $3.00.

From 4th international symposium on fresh water from the sea; Heidelberg, F.R. Germany (9 Sep 1973).

The heat transfer efficiency of multistage flash and vertical tube distillation desalting plants may be impaired by a variety of foulants which deposit on the heat transfer tubing. Fouling can occur both tubeside and steamside. Corrosion product films are formed in situ due to oxidation of the tube material, and iron oxide from corrosion of the evaporator internals may be deposited gradually both tubeside and steamside. Rapid tubeside fouling can occur during periods of maloperation (e.g., a power outage or pump failure) due to deposition of alkaline scales, $Mg(OH)_2$ and/or $CaCO_3$ or of calcium sulfate scale in one of three forms—gypsum, $CaSO_4 \cdot 2H_2O$, hemihydrate, $CaSO_4 \cdot 1/2H_2O$, or anhydrite, $CaSO_4$. Silica, organic material and corrosion product oxides are usually codeposited with these foulants. Solutions of hydrochloric, sulfamic or citric acid containing suitable inhibitors are satisfactory cleaning agents for films of corrosion products and for alkaline scales. Tubeside deposits of gypsum and hemihydrate have been removed by circulating ambient seawater and brine solutions. The more troublesome anhydrite can be removed by high-pressure water jets (hydrolancing) or by circulating warm solutions of chelating agents or proprietary chemical compounds through the tubes. The results of laboratory tests and of in-plant cleaning demonstrations are described and the costs of the various methods of cleaning are compared. Data are presented on the recovery of heat transfer performance obtained after various cleaning operations,

particularly with high-performance enhanced surface heat transfer tubing. (auth)

12808 (EUR-4820(Vol. 6)(Pt. L), pp 11-26) HEAT CONDUCTION IN MULTICONNECTED COMPOSITE REGIONS WITH RADIATION BOUNDARY CONDITIONS. Hulbert, L. E. (Battelle Memorial Inst., Columbus, OH). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The boundary-point least-squares method is used to determine the approximate steady-state temperature distribution in composite regions that involve heat transfer by the nonlinear fourth-power radiation law. The nonlinear boundary equations are solved by way of a modified successive-approximation scheme. The details of the solution technique are developed and several example problems solved. (auth)

12809 (RD/B/N-2627) THERMODYNAMIC AND TRANSPORT PROPERTIES FOR A MIXTURE OF HELIUM WITH 1% BY VOLUME CARBON DIOXIDE. Easby, J. P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Mar 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The properties of a mixture of helium and 1% by volume carbon dioxide have been calculated and tabulated for pressures of 1 to 50 bars and temperatures of 100 to 800°C. The data are intended for use in reactor calculations subject to the acceptability of the accuracy stated. (auth)

12810 (TRG-2459) TOPAL: A COMPUTER CODE FOR INVESTIGATING METAL-LIQUID THERMAL INTERACTIONS IN SHOCK-TUBE GEOMETRY. Part 1. Theoretical Description. Morgan, K. (Atomic Weapons Research Establishment, Aldermaston (England)). Jun 1973. 11p. (GRO-44/91/26). Dep. NTIS (U. S. Sales Only) $3.00.

A description is given of the computer program TOPAL which was written to investigate metal-liquid thermal interactions under shock tube conditions. The program solves the Lagrangian equations of motion for one-dimensional unsteady compressible fluid flow in plane geometry. (auth)

12811 MECHANISMS OF HEAT TRANSFER IN HEAT PIPES AND THERMOSYPHONS. Sookalingam, K. C.; Schrock, V. E. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 16: 3-4(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12812 INTRINSIC EQUATIONS FOR HYDROMAGNETIC FLOWS. Suryanarayan, E. R. Rev. Roum. Math. Pures Appl.; 17: No. 1, 103-112(1972).

Steady nondissipative magnetogasdynamic flow was studied by obtaining the intrinsic governing equations. These equations are expressed in terms of the geometry of the family of surfaces containing the flow and the field lines. Against this background, the properties of helicoidal flows were studied. (App. Mech. Rev.)

12813 LINEAR STABILITY OF FLOW IN A CIRCULAR PIPE IN THE PRESENCE OF A STRONG TRANSVERSE MAGNETIC FIELD. Baldwin, P. Quart. J. Mech. Appl. Math.; 25: No. 3, 333-349(Aug 1972).

It is stated that an electrically conducting fluid with constant fluid properties flows in a circular pipe with an insulating wall under the action of a strong uniform transverse magnetic field. Linear stability analysis of MHD equations governing the flow, in the small magnetic Reynolds number approximation, shows that instabilities arise in the Hartmann layer on the plane of symmetry parallel to the magnetic field, where velocity gradients are greatest. The first two terms in asymptotic expansions for the Reynolds number and for the wave number and wave speed of the disturbance are obtained for the onset of marginal stability at large Hartmann number. Experimental results of Gardner and Lykoudis attached particular significance to the singular regions of the Hartmann layer, whereas it was found that instabilities first arise outside of these regions. (Appl. Mech. Rev.)

12814 NUCLEATION OF SODIUM BOILING FROM SURFACE CAVITIES CONTAINING GAS. Holland, P. K.; Winterton, R. H. S. (Central Electricity Generating Board, Berkeley, Eng.). Int. J. Heat Mass Transfer; 16: No. 7, 1453-1458(Jul 1973).

An analytical expression is derived for the increase in vapor pressure required for the nucleate boiling of sodium due to diffusion of inert gas out of surface cavities. This results in an increase of superheat with heating time. The main result of the theory is confirmed quantitatively by the experimental work described. (auth)

12815 DEVELOPMENT OF FREE CONVECTION AXIAL FLOW THROUGH A TUBE BUNDLE. Davis, L. P.; Perona, J. J. (Univ. of Tennessee, Knoxville). Int. J. Heat Mass Transfer; 16: No. 7, 1425-1428(Jul 1973).

Consideration is given to an open tube bundle immersed in a fluid. The tubes, which are oriented vertically, generate heat and the fluid enters the bottom of the bundle with uniform velocity and temperature and flows up through the bundle outside of the tubes. The flow is assumed to be stable and laminar. Thermal boundary layer equations were solved for pitch-to-diameter ratios of 1.2 to 2.0 with air as the fluid, allowing density, viscosity, and thermal conductivity to vary with temperature. Local Nusselt numbers were correlated with a modified Graetz number and showed parametric dependence on both pitch-to-diameter ratio and dimensionless flow rate. Correlations of dimensionless flow rate with dimensionless tube bundle length were unaffected by considerations of variable physical properties provided the dimensionless flow rates were evaluated at outlet conditions. Experiments performed on two tube bundles (pitch-to-diameter ratios of 1.68 and 2.03) under the condition of constant wall heat flux verified the theoretical predictions of Nusselt numbers. Predicted flow rates were displaced below the predicted curves due to constructions in the flow area caused by the tube spacers. (auth)

12816 DYNAMIC-BIAS IN RADIATION INTERROGATION OF TWO PHASE FLOW. Harms, A. A.; Laratta, F. A. R. (McMaster Univ., Hamilton, Ont.). Int. J. Heat Mass Transfer; 16: No. 7, 1459-1465(Jul 1973).

An analysis is presented concerning the dynamic-bias which appears in radiation interrogation of fluctuating two-phase flow. It is shown that in certain cases it is possible to obtain closed form expressions for the dynamic-bias. Based on these analytical and calculational results, conditions are enumerated which must be emphasized if the dynamic-bias is to be minimized. (auth)

Materials Testing

Refer also to abstracts 12988, 14403, 14827, and 14828.

12817 (SLA-73-467) RESPONSE OF AN ELASTIC RING TO AN EXPLOSIVELY INDUCED IMPULSIVE LOAD. Mitchell, D. E. (Sandia Labs., Albuquerque, N. Mex.). Jun 1973. 28p. Dep. NTIS $3.00.

The structural impulsive loading technique which employs explosive rods placed over a foam mitigator is evaluated for a specific structural geometry and loading. The explosive assembly was designed to simulate a cosine-distributed impulse over half the circumference of aluminum rings with a 36-inch outer diameter. Accuracy of the method is demonstrated by comparing theoretical predictions and measured strains from two experiments which had peak impulse intensities of 2300 and 2600 taps. It is concluded that the rod-over-foam impulse technique is adequate for this structural geometry and loading. (auth)

12818 OVERVIEW OF IMAGE PROCESSING. Janney, D. H. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 46-47(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12819 NONDESTRUCTIVE TESTING FOR STEAM GENERATORS. McClung, R. W.; Foster, B. E.; Cook, K. V.; Dodd, C. V. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 84(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12820 TRANSDUCER DESIGN CONSIDERATIONS FOR ULTRASONIC INSPECTION OF NUCLEAR REACTORS. Karplus, H. B. (Argonne National Lab., IL); Massow, R. B.; Williams, R. L. Trans. Amer. Nucl. Soc.; 16: 84-85(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12821 ACOUSTIC EMISSION MONITORING OF PROOF TESTS AND SIMULATED IN-SERVICE NUCLEAR PRESSURE VESSELS. Bell, R. L.; Kelly, M. P.; Dunegan, H. (Dunegan/Endevco, Livermore, CA). Trans. Amer. Nucl. Soc.; 16: 85-86(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12822 EXPERIMENTAL COMPARISON OF THE UNFUELED ^{252}Cf NEUTRON RADIOGRAPHY DEVICE WITH A MULTIPLIER. Bakevich, G. J. (Univ. of Utah, Salt Lake City); Miller, L. G.; Kunze, J. F.; Sandquist, G. M. Trans. Amer. Nucl. Soc.; 16: 87-88(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12823 NONDESTRUCTIVE TESTING OF PULSED REACTOR FUELS. Horak, J. A.; Karnowsy, M. M.; Sasmor, D. J. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 16: 89(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12824 NONDESTRUCTIVE TESTING. Second Edition. McGonnagle, W. J. New York; Gordon and Breach, Science Publishers, Inc. (1961). 463p. $38.50.

Nondestructive testing is examined in detail with an introductory discussion of general testing methods, methods for verifying test results, and the advantages and uses of nondestructive testing. Separate chapters describe: visual testing; pressure and leak testing; thickness measurements; liquid penetrant inspection; thermal methods; x-ray radiography; gamma radiography; ultrasonics; dynamic testing; magnetic methods; electrical methods; eddy current methods; and other useful testing techniques. A subject index is provided. (LCL)

12825 ADVANCED RADIOGRAPHIC IMAGING TECHNIQUES. Beal, J. B.; Brown, R. L. (Marshall Space Flight Center, Huntsville, AL). Mater. Eval.; 31: No. 7, 133-144(1973).

The need for reduction of space vehicle costs coupled with increased demands for high reliability, as dictated by long duration mission requirements, has required that NASA continuously scrutinize and improved quality assurance methods wherever possible. X-radiography has been extensively employed as a primary hardware inspection method. Neutron radiography has been applied to the analysis of ordnance devices. This paper examines the nature and operational constraints of conventional x-radiographic and neutron imaging methods, thereby providing a foundation for the discussion of advanced radiographic imaging systems. Two types of solid-state image amplifiers designed to image x rays are described. Operational theory, panel construction, and performance characteristics are discussed. A closed-circuit television system for imaging neutrons is described also, and the system design, operational theory, and performance characteristics are outlined. Emphasis is placed on a description of the advantages of these imaging systems over conventional methods. (14 figures, 17 references.) (auth)

12826 ULTRASONIC MEASUREMENTS OF COLD-WORK PERCENTAGES IN TYPE 316 STAINLESS STEEL. Reimann, K. J.; Carson, N. J. (Argonne National Lab., IL). Mater. Eval.; 31: No. 7, 128-132, 144(1973).

Rayleigh critical-angle reflectivity constitutes a suitable method of determining cold-work percentages. Type 316 stainless steel samples with a chemical composition that varied within the tolerances of ASTM standards and with different percentages of cold work were fabricated and examined by the critical-angle reflectivity method. The test arrangement described is suitable for measurements of flat as well as tubular samples. The quantitative relation between microhardness and critical angle measured in Type 316 stainless steel resembled much the same relation reported for Type 304 stainless steel. The variation of the critical angle is compared with the direction of cold working for different percentages of cold work, and the effect of chemical variation on the measurement is discussed. Some ideas for modification of the laboratory test arrangement into an on-line inspection system are expounded. (8 figures) (auth)

Nuclear Explosions

Refer also to abstracts 13131, 13367, and 13368.

12827 (AD-753059) QUALITATIVE PROPERTIES OF THE F DETECTOR. Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 23 Jun 1972. Contract F33657-72-C-0009. 44p. (SDL-291). NTIS.

It is shown that an F detector reduces the number of beams in velocity space over which a search must be made before declaring a short period seismic array detection, that its main detection lobe is satisfactorily wide for practical purposes, and that simple F detection is poor at detecting mixed signals. Design considerations are given for selection of particular detection algorithms for different sizes and types of arrays. (auth)

12828 (NVO-86(Rev.3)) REPORTS AVAILABLE IN PLOWSHARE OPEN FILE. (Nevada Operations Office (AEC), Las Vegas). Jul 1973. 44p. Dep. NTIS $4.00.

Publications concerning Gasbuggy, Rio Blanco, Rulison, and Wagon Wheel that have been placed in the Plowshare Open Files by the Nevada Operations Office are listed. Addresses for ordering and/or viewing the publications are given. (TFD)

12829 (PNE-R-41) YIELD ESCALATION EVALUATION, PROJECT RULISON. (Cer Geonuclear Corp., Las Vegas, Nev.). 15 Jun 1972. Contract AT(26-1)-429. 42p. Dep. NTIS $4.25.

Equations necessary to formulate seismic safety programs for future nuclear detonations in the Project Rulison area are presented. Using these equations, it is possible to apply predictive techniques to estimate the damage to be expected from such explosions. The formulae derived and the conclusions reached in this report are those of CER and no concurrence by the AEC is meant or implied. The safety criteria presented are those that were used by the Atomic Energy Commission on the Rulison event. Their presentation does not imply CER's concurrence. The observed effects from the first Rulison detonation seem to indicate that the criteria are overly restrictive and that some relaxation could be made without increasing the safety hazard. (auth)

12830 (SLA-73-337) COMPARISON OF POST-SHOT PREDICTION AND RECORDED RESPONSE TO AN AIRBLAST. Ellett, D. M. (Sandia Labs., Albuquerque, N. Mex.). Jun 1973. 15p. Dep. NTIS $3.00.

A response reconciliation, based on previously recorded data that were not specifically collected for the purpose, has been attempted for the response of a house to the air blast from the Trinidad Explosion D-1. Although reasonable results were obtained, without a local pressure measurement near the house, uncertainty in the blast signature precludes more effort on the calculations. For future similar tests it is recommended that appropriate instrumentation be planned and provided. (auth)

12831 (UCID-15610(Rev.1)) NEVADA AUTOMATED DIAGNOSTICS (NAD) SYSTEM. Rufer, R. (ed.). (California Univ., Livermore, Lawrence Livermore Lab.). 3 Feb 1970. Contract W-7405-eng-48. 75p. Dep. NTIS $5.75.

The computer-aided data acquisition system which will be installed at the Nevada Test Site is described in detail. Data multiplexing, control and monitor system, central controller concepts, system software, user-terminal system, recording and switching system, communications system, and data acquisition systems and interfaces are described. (WHK)

12832 (UCRL-51318) SIMULATION OF THE LLL BENIOFF SEISMIC SYSTEM. Denny, M. D. (California Univ., Livermore. Lawrence Livermore Lab.). 4 May 1973. Contract W-7405-Eng-48. 54p. Dep. NTIS $5.45.

For the past decade the Laboratory has conducted a seismic yield measurement program in support of the nuclear testing program at the Nevada Test Site. Initially, two stations were equipped with a short-period vertical-component seismometer and film recorder system designed by Hugo Benioff. Later this system was replaced by a long-period broad-band telemetry system. Since much of the data currently used in the seismic yield determination consists of data recorded on the Benioff system, an equivalent Benioff signal must be filtered from the data recorded on the broad-band system. To determine that signal, the Benioff system was removed from storage and set up for critical laboratory measurements. Unfortunately the damping of the seismometer and of the film recorder galvanometers could not be reconstructed in the lab. Consequently, it was necessary to deduce these values from parameter studies and from routine response tests conducted in the field prior to the recording of a nuclear event. The parameter studies were made with a recursive filter code that simulates the Benioff system. The damping values finally arrived at are compromises as the field tests showed that considerable variation existed from event to event. Nevertheless, the recursive filter code satisfactorily reproduced the Benioff data from the broad-band data when tested against actual Benioff data. (auth)

12833 (UCRL-51352) PHYSICS OF SOC AND TENSOR. Schatz, J. F. (California Univ., Livermore. Lawrence Livermore Lab.). 21 Feb 1973. Contract W-7405-eng-48. 47p. Dep. NTIS $4.00.

SOC and TENSOR (respectively, one and two dimensional finite difference computer codes for the calculation of stress wave propagation) are described in some detail from a physical viewpoint. Both codes were developed primarily for computing the geophysical effects of nuclear explosions. Emphasis is placed on the treatment of constitutive relations (equations of state) as this is the facet of the calculational method which most often causes difficulties. It is shown that not all of the models are entirely physically or numerically plausible, but that they are often adequate if understood and manipulated properly. Several sample calculations are presented. It is concluded that SOC and TENSOR require extensive revision. To this end, a new one-dimensional code, called SOC73, has been developed, and an improved two-dimensional code is being formulated. (auth)

12834 (UCRL-73912) PROVIDING AN EARTHQUAKE-LIKE ENVIRONMENT FOR TESTING FULL-SCALE STRUCTURES BY USING THE GROUND MOTION FROM UNDERGROUND NUCLEAR TESTS. Bernreuter, D. L.; Tokarz, F. J. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Dec 1972. 6p. (CONF-730629-1). Dep. NTIS $3.00.

From fifth world conference on earthquake engineering; Rome, Italy (25 Jun 1973).

Close-in ground motions from underground nuclear explosives (UNEs) are compared with those from strong earthquakes (EQs). UNE ground motions are considered typical for yields of approximately 10 and 200 kt (kilotons) explosives. It is shown that (1) the peak g-levels of the strongest EQs can easily be duplicated or exceeded (if desired) by UNEs, (2) the response spectra from UNEs are similar to those from EQs, and (3) the duration of strong motion and number of near-peak g-level cycles of UNE ground motion is within the range established by strong EQs. It is concluded that ground motion from UNEs can produce a sufficiently EQ-like environment for testing full-scale structures. (auth)

12835 (UCRL-74530) FORMULAS FOR CANISTER AND PIPE DESIGN IN UNDERGROUND NUCLEAR EMPLACEMENT. Blake, A. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Feb 1973. 21p. (CONF-730626-1). Dep. NTIS $3.25.

From ASME meeting; Miami Beach, Florida, USA (24 Jun 1973).

Pressure-vessel theory and practice are applied to the analysis and design of long emplacement strings and canister hardware used in a complex environment of underground nuclear tests. Design formulas are given for the collapse pressure of canisters and piping under external soil pressure and for the axial response of gussetted flanges supported by the theoretical and experimental results. A practical treatment of a complex problem of structural response with the aid of user-oriented, closed form solutions is presented. (auth)

12836 (UCRL-74814) ELECTROMAGNETIC PULSE: NUMERICAL METHODS AND APPLICATIONS. Miller, E. K. (California Univ., Livermore. Lawrence Livermore Lab.). 18 Jun 1973. 61p. Dep. NTIS $5.25.

A brief overview of some numerical methods, primarily integral equation types which have been developed for or applied to nuclear EMP survivability/vulnerability assessment problems, is presented. Results of sample calculations are presented for a variety of wire and surface structures in both the time and frequency domains. Also discussed are some of the problems associated with the development of an engineering approximation methodology for EMP applications. (auth)

12837 IMPORTANCE OF THE DELAYED RADIATION FROM A NUCLEAR WEAPON BURST. Straker, E. A.; Allen, L. C.; Street, K. D. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 16: 336(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12838 REVIEW OF BLOWOFF IMPULSE TECHNOLOGY. Reaugh, J. H. (Physics International Co., San Leandro, CA). Trans. Amer. Nucl. Soc.; 16: 355-356(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12839 SIMULATION OF HIGH DOSE RATE X-RAY EFFECTS. Huntington, J. H. (Physics International Co., San Leandro, CA). Trans. Amer. Nucl. Soc.; 16: 357(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12840 COUPLED TORSIONAL DYNAMIC ANALYSIS OF A MULTISTORY BUILDING. Douglas, B. M.; Trabert, T. E. (Univ. of Nevada, Reno). Bull. Seismol. Soc. Amer.; 63: No. 3, 1025-1039(Jun 1973).

The coupled bending and torsional vibrations of a relatively symmetric 22-story reinforced concrete building in Reno, Nevada are studied. Analytical results are compared with observations obtained during the nuclear explosion FAULTLESS and to ambient vibration data. The fundamental periods of vibration observed during FAULTLESS were (T_{NS} = 1.42, T_{EW} = 1.81, $T_{TORSION}$ = 1.12 s), and the calculated periods were (T_{NS} = 2.14, T_{EW} = 2.07, $T_{TORSION}$ = 1.90 s). It was estimated that between 25 and 45% of the total available nonstructural stiffness was required to explain the differences in the observed and calculated fundamental periods. Each floor diaphragm in the system was allowed three degrees of freedom-two translations and a rotation. It was found that coupled torsional motions can influence the response of structural elements near the periphery of the structure. Strong-motion structural response calculations comparing the simultaneous use of both components of horizontal ground motion to a single component analysis showed that the simultaneous application of both components of ground motion can significantly alter the response of lateral load-carrying elements. Differences of the order of 45% were observed in the frames near the ends of the structure. Also, it was shown that the overall response of tall buildings is sensitive not only to the choice of input ground motion but also to the orientation of the structure with respect to the seismic waves. (auth)

12841 SIMULATIONS OF THE UNDERGROUND EXPLOSIONS GENERATING LONGITUDINAL AND TRANSVERSE WAVES. Enescu, D.; Georgescu, A.; Marza, V. (Inst. of Applied Geophysics, Bucharest). Bull. Seismol. Soc. Amer.; 63: No. 3, 753-763(Jun 1973).

For the purpose of modeling the process noticed by Kim and Kisslinger (1967) regarding the generation of the two wave types (P and S) by underground explosions produced in spherical cavities, a generalization of Sharpe's (1942) and Blake's (1952) solution is made. The expression for the transfer function of the source was established. By means of this function, two electronic models for the simulation of underground explosions generating longitudinal and transverse waves were designed. (auth)

12842 THEORETICAL MODEL FOR THE PROCESS OF UNDERGROUND EXPLOSIONS. Contributions to The Problem of The Separation of Large Explosions From Earthquake. Enescu, D.; Georgescu, A.; Jianu, D.; Zamarca, I. (Inst. for Applied Geophysics, Bucharest). Bull. Seismol. Soc. Amer.; 63: No. 3, 765-785(Jun 1973).

The theoretical model of a source was obtained by combining three unequal couples without moment; further, each couple was combined with a simple force, the intensity of which is also dependent on the direction in which this force is acting. This model attempts to explain not only the process of explosion radiation of both P- and S-wave types, but also the co-occurrence of both the anaseismic (compressions) and the kataseismic (dilatations) motions in the P wave. A few examples of large underground explosions are given, which have a mechanism that may be satisfactorily explained by means of the theoretical model presented. (auth)

12843 JOINT MAGNITUDE DETERMINATION AND ANALYSIS OF VARIANCE FOR EXPLOSION MAGNITUDE ESTIMATES. Von Seggern, D. (Teledyne Geotech, Alexandria, VA). Bull. Seismol. Soc. Amer.; 63: No. 3, 827-845(Jun 1973).

A least-squares procedure which simultaneously estimates station corrections, event magnitudes, and an attenuation rate is used as a basis for analyzing the variance of explosion magnitudes. This procedure is here termed "joint magnitude determination" (JMD). The JMD method is applied to Seismic Data Laboratory (SDL) data from North American stations for Nevada Test Site explosions. The standard deviation of station magnitudes (M_S and m_b) computed by JMD for an event typically is one-half of the standard deviation of magnitudes computed by routine methods. This reduction is wholly due to the addition of station terms. Surprisingly, no consequent reduction in scatter of the explosion M_S versus m_b plot was attained by using JMD estimates rather than routine ones. To resolve this paradox, the scatter of magnitude estimates is divided into three distinct parts: source, path-station, and measurement. The absolute value for each part is derived from the seismic measurements without using yield information. After path-station effects and measurement noise are suppressed, it is found that source effects contribute significantly to magnitude bias for explosions, thus explaining the failure of the JMD method to reduce M_S versus m_b scatter. (auth)

12844 REVISED VELOCITIES IN THE EARTH'S CORE. Qamar, A. (Univ. of California, Berkeley). Bull. Seismol. Soc. Amer.; 63: No. 3, 1073-1105(Jun 1973).

Travel times and amplitudes of PKP and PKKP from three earthquakes and four underground nuclear explosions are presented. Observations of reflected core waves at nearly normal angles of incidence provide new constraints on the average velocities in the inner and outer core. Interpretation of these data suggests that several small but significant changes to Bolt's (1962) core velocity model (T2) are necessary. A revised velocity model KOR5 is given together with the derived travel times that are consistent with the 1968 tables for P. Model KOR5 possesses a velocity in the transition zone which is 1½% lower than that in model T2. In addition, KOR5 has a velocity jump at the transition zone boundary (r = 1782 km) of 0.013 km/s and a jump at the inner core boundary (r = 1213 km) of 0.6 km/s. These values are, respectively, $\frac{1}{20}$ and $\frac{2}{3}$ of the corresponding model T2 values. (auth)

12845 DETERRENCE AND FALSE ALARMS IN SEISMIC DISCRIMINATION. Weichert, D. H.; Basham, P. W. (Department of Energy, Mines and Resources, Ottawa). Bull. Seismol. Soc. Amer.; 63: No. 3, 1119-1132(Jun 1973).

The statistical capabilities of $M_S:m_b$ earthquake-explosion discrimination are derived from cumulative distributions of a linear discrimination parameter with confidence limits estimated by a distribution-free method. Cumulative discriminant distributions are shown to be preferable to previously employed "operating characteristics" because of difficulties of construction and interpretation of the latter. Three sets of $M_S:m_b$ discrimination data, two regional (North American and Eurasian) and one global, are employed to estimate false alarm probabilities at given "deterrence" (probability of correct identification of an explosion) for situations of both a ban and no ban on underground testing. In the hypothetical situation of monitoring a test ban using the $M_S:m_b$ criterion, reasonable deterrence (nominally 30% with a 95% confidence that it is greater than 10%) will be accompanied by a false alarm probability estimated from global data of about 0.1%. (auth)

12846 NUCLEAR TESTS: FRANCE'S UNWELCOME EXPORT TO THE SOUTH PACIFIC. Carter, L. J. Science; 181: No. 7, 251-252(1973).

A general criticism of France's atmospheric nuclear explosions in the South Pacific is presented. (TFD)

12847 LINEAR Q AND THE CALCULATION OF DECAYING SPHERICAL SHOCKS IN SOLIDS. Viecelli, J. A. (Univ. of California, Livermore). J. Comput. Phys.; 12: No. 2, 187-201 (Jun 1973).

The effect of the linear Q on the decay of a spherical shock wave in a solid, as calculated by Lagrangian finite difference techniques, is determined by a study of the partial differential equations approximated by the difference equations. It is shown that the computed solutions approach an asymptotic form determined by the linear Q terms, and the decay law imposed by the linear Q is given. Finally, it is suggested that the physics of the weak decaying shock problem indicate that the numerical linear Q needs to be replaced by terms modeling a true physical damping mechanism. (auth)

12848 SEISMIC MOMENT AND LONG-PERIOD RADIATION OF UNDERGROUND NUCLEAR EXPLOSIONS. Mueller, G. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). Bull. Seismol. Soc. Amer.; 63: No. 3, 847-857(Jun 1973).

The moment function of an explosion is introduced, using the equivalence of an explosive point source and three mutually perpendicular linear dipoles. The seismic moment of an explosion is the final value, for large times, of the moment function. Its relation to source parameters is similar to that of the moment of an earthquake: $M_1 = (\lambda + 2\mu)\, S_1 D_1$ (λ,μ = Lamé's parameters, S_1 = surface area of a sphere surrounding the explosion in the elastic zone, D_1 = static radial displacement on this sphere). From strain observations of other authors (Romig et al., 1969; Smith et al., 1969), the moment of the underground nuclear explosion BENHAM is estimated to be about 10^{24} dyne cm. This moment value supports the assumption that the source-time function for the long-period radiation from large nuclear explosions (periods greater than about 10 sec) is essentially a step-function. On the other hand, a quantitative estimate of the long-period P-wave spectrum of the explosions JORUM, HANDLEY and MILROW and a comparison with observed spectra of Molnar (1971) for JORUM and HANDLEY and Wyss et al. (1971) for MILROW support the assumption of an impulsive source-time function. This discrepancy, which is typical of current opinions among seismologists, is not resolved. It is concluded that an explosive point source is possibly not a sufficient model for the long-time radiation and the static displacement field of a nuclear underground explosion whose elastic radius is about equal to its depth and which is detonated in a prestressed medium. (auth)

Protective Structures and Equipment

12849 TRITIUM AND RADIOPROTECTION. Bardolle, G. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France); Peyresblanques, H.; Rebiffe, J.; Lalu, D. Bull. Inform. Sci. Tech. (Paris); No. 178, 83-104(Feb 1973). (In French).

The activities encountered when handling tritium necessitate the utilization of special protection measures. The various methods used for monitoring the site and working personnel are outlined. Practical examples of applied radioprotection are given. (FR)

12850 ETO DOLZHEN ZNAT' KAZHDYI. (Everyone Should Know This). Moscow; Voennoe Izdatel'stvo Ministerstva Oborony SSSR (1973). 48p.

Fundamental techniques in civil defense are presented in terms of the individual and his role in the event of a nuclear explosion. Gas masks, and other protective clothing, fallout shelters, and dosimetric control are explained to the layman. (KSW)

Safety Engineering

12851 SODIUM PROPERTIES FOR MFCI ANALYSES. Padilla, A. Jr.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 184-185(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 12657.

Radioactive Effluents

Refer also to abstracts 12864, 12877, 12882, and 14598.

12852 NUMERICAL STUDY OF WET COOLING TOWER PLUME. Lee, J. L. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 16: 32-33(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12853 EFFECT OF PLUME RISE ON THE PARAMETERS DETERMINING THE MAXIMUM GROUND CONCENTRATION OF EFFLUENTS. Yeh, C. S. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc.; 16: 33-34 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12854 REGULATION OF A FUEL REPROCESSING PLANT: A CASE STUDY. Reister, D. B. (State Univ. of New York, Buffalo). Trans. Amer. Nucl. Soc.; 16: 40(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12855 UP-TO-DATE METHODS IN THE ENVIRONMENTAL CONTROL OF NUCLEAR ESTABLISHMENTS. Feher, I.; Erdelyvari, I. (MTA Koezponti Fizikai Kutato Intezete, Budapest). Izotoptechnika; 16: No. 4, 199-208(Apr 1973). (In Hungarian).

Hazards of peaceful uses of atomic energy, analytical methods of environmental control, and control systems at the Central Research Institute of Physics of the Hungarian Academy of Sciences are discussed. (auth)

Radioactivity Monitoring and Transport

Refer also to abstract 12765.

12856 (BNWL-1697) CONSIDERATIONS IN THE ASSESSMENT OF THE CONSEQUENCES OF EFFLUENTS FROM MIXED OXIDE FUEL FABRICATION PLANTS. Selby, J. M.; Watson, E. C.; Corley, J. P.; Waite, D. A.; Carter, L. A.; Droppo, J. G.; Clark, R. G.; Brown, C. L.; Williams, L. D.; Hall, R. J.; Schwendiman, L. C.; Mishima, J.; Woodruff, R. K.; McSweeney, T. I.; Burnham, J. B. (Battelle Pacific Northwest Labs., Richland, Wash.). Jun 1973. Contract AT(45-1)-1830. 159p. Dep. NTIS $7.60.

The purpose of this study is to provide information and identify parameters relevant to assessing the consequences to man and his environment of large scale mixed plutonium-uranium oxide fuel fabrication plants which will be needed in the next 10 to 15 years. The report identifies the pertinent parameters, values, factors and methods which may be used in evaluating the environmental consequences of routine plant operation as well as postulated accidents. A comprehensive view of the technological considerations germane in analyzing the safety of a plutonium fuel fabrication facility are reviewed. Additionally, it quantifies the risk for the fuel fabrication operations and more importantly, identifies the areas where special safety emphasis should be placed. Effort should continue toward developing improved safety procedures and refining the release probabilities for operations involving the greatest risk. (DHM)

12857 (COO-3568-3) PLUTONIUM CONCENTRATION ALONG FRESH WATER FOOD CHAINS OF THE GREAT LAKES, U. S. A. General Summary of Progress, 1972-1973. Bowen, V. T.; Noshkin, V. E. (Woods Hole Oceanographic Institution, Mass.). 1973. Contract AT(11-1)-3568. 35p. Dep. NTIS $3.75.

The following radiochemical data are tabulated for analyses of samples in Lake Ontario during 1972: ^{239}Pu, ^{137}Cs, and ^{90}Sr values in water samples; ^{238}Pu, ^{239}Pu, ^{137}Cs, and ^{90}Sr values in sediment samples; and ^{239}Pu and ^{137}Cs values in plankton, fishes, and clams. A discussion is presented of the quality of the data. The results indicated that bottom-feeding fish such as the gizzard shad, redhorse sucker, carp, bullhead, or drum had higher ^{239}Pu concentrations than predators such as yellow perch or largemouth bass. The data were not consistent with a very striking food-chain magnification of plutonium in fresh-water ecosystems. It is suggested that plutonium concentrated on silt particles is remobilized by digestive processes of filter feeders or bottom feeders and that there may be rather large differences among species with regard to the efficiency of this. (HLW)

12858 (RLO-2225-T-14-5) STUDIES OF THE NATURAL ALPHA-EMITTING RADIOISOTOPES IN MARINE ORGANISMS. Annual Progress Report, 1972-1973. Schell, W. R. (Washington Univ., Seattle. Lab. of Radiation Ecology). 1 May 1973. Contract AT(45-1)-2225. 31p. Dep. NTIS $3.75.

Progress is reported on the following research projects: effects of contamination of samples by environmental Pb, ^{210}Po, and ^{210}Pb on techniques for monitoring; use of large-volume water samples for determining particulate and soluble components of Pb, ^{210}Po, and ^{210}Pb in aquatic environments; sources and transport processes occurring from input through concentration in marine biota to loss in the geochemical sink; ^{210}Pb-^{210}Po sediment dating; concentrations of ^{210}Po and ^{210}Pb contributing to the radiation dose in tideland organisms (oysters, copepods, salmon); application of ^{210}Pb-^{210}Po sediment dating techniques to fresh and salt water environments; and use of NaI(Tl) and Ge(Li) detectors for determining gamma-emitting radionuclides in biota. (HLW)

12859 USES OF GAMMA-RAY SPECTROMETRIC MEASUREMENTS IN RADIOLOGICAL SURVEILLANCE AT NUCLEAR POWER FACILITIES. Kahn, B. (Environmental Protection Agency, Cincinnati). Trans. Amer. Nucl. Soc.; 16: 67-68(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

Atmosphere

Refer also to abstract 12877.

12860 (ARLV-351-28) NUMERICAL PREDICTION OF THE MESOSCALE TRANSPORT OF ATMOSPHERIC EFFLUENTS: PHILOSOPHY AND MORPHOLOGY OF EXPERIMENTAL MODELS FOR PREDICTING THE WIND AND POTENTIAL RADIOLOGICAL FIELDS OVER THE NEVADA TEST SITE. Randerson, D.; Cornett, J. S. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Air Resources Lab.). May 1973. 61p. Dep. NTIS $3.00.

Two experimental numerical models are described and tentatively verified. One model predicts the mesoscale wind field over mountainous terrain and the other model forecasts the temporal and spatial changes in the airborne radioactivity field that might be associated with an accidental release of debris during nuclear testing on the Nevada Test Site. A mesoscale wind-prediction model is derived from the assumption of the conservation of vertical wind shear for a time period of at least 6 hr over an area 160 × 160 n mi. This assumption is closely analogous to the conservation of horizontal vorticity. Verification of the wind-prediction model is accomplished through two different modes. First, 10 independent cases of different wind regimes are used to verify the wind predictions for three different stations. The average root-mean-square error in speed for these stations varies from 6.2 kt for a 1-hr prediction to 9.8 kt for a 6-hr prediction. Second, for 20 different independent cases, comparisons against persistence forecasts and wind-ladder forecasts, prepared by the duty forecaster for Yucca Flat, show that the model did as well as both for a 2-hr prediction and better than both for a 6-hr prediction. The radiological-prediction model is difficult to verify, but preliminary results look realistic. In the single case used to verify the radiological forecasts, the model predicts the path of the debris cloud to be too far east by about 13 n mi, 2 hr after detonation, and by about 20 n mi, 3 hr after detonation. Above the 7000-ft level, the speed of movement of the cloud center is too fast by about 10 to 15 kt for a 3.5-hr forecast. The 7000-ft trajectory compares reasonably well with the estimated cloud positions reported by pilots, the predicted cloud-center trajectory being within about 8 n mi of the estimated cloud centroid throughout the duration of a 4-hr forecast. (auth)

12861 (BNWL-SA-4534) ANALYTICAL TECHNIQUE FOR DISTRIBUTING AIR SAMPLING LOCATIONS AROUND NUCLEAR FACILITIES. Waite, D. A. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. 12p. (CONF-730603-9). Dep. NTIS $3.00.

From 18th health physics society meeting; Miami Beach, Florida, USA (17 Jun 1973).

In an attempt to provide a consistent, uncomplicated, economical mechanism for the examination of surveillance systems, a search was begun for factors which influence a system's ability to assess population exposures and which could be incorporated into a workable sampling location distribution procedure. An examination of parameters involved in release mechanisms, transport models, and exposure pathways for airborne releases from nuclear fuel cycle facilities, revealed that population exposure magnitudes were most directly related to population and contaminant transport characteristics of the site involved. (DHM)

12862 COMPARISON OF CALCULATED AND MEASURED PLUME EXPOSURE. Gogolak, C. V. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 16: 31(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12863 SELECTION OF MONITORS FOR AIRBORNE PARTICULATE RADIOACTIVITY. Bleher, G. L.; Holloway, D. J. (Gulf Energy and Environmental Systems, San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 35(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12864 GEOMETRICAL CONSIDERATIONS IN ^{16}N SITE BOUNDARY DOSE CALCULATIONS. Normand, E.; Rooney, K. L.; Romano, R. R.; De Lise, W. E. (Sargent and Lundy Engineers, Chicago). Trans. Amer. Nucl. Soc.; 16: 340-341 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

Soil

Refer also to abstract 15136.

12865 (LA-5286-MS) UNDERGROUND MOVEMENT OF TRITIUM FROM SOLID-WASTE STORAGE SHAFTS. Purtymun, W. D. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

Tritium from contaminated wastes placed in storage shafts was transported by moisture into the adjacent tuff. A study made to determine the extent and geologic factors governing this movement indicates that 100 pCi/ml levels have moved westward a distance of 105 ft in 4 yr. Major movement was along the contact between the two ashflows penetrated by the shafts, with secondary transport through open joints and through the tuff matrix. Evaporation from surface soil and tuff and transpiration from plants was a contributing factor in the release of tritium to the atmosphere. (auth)

12866 LEACHING OF STRONTIUM-90 FROM SOIL BY SURFACE WATER. Pisarev, V. V. (Inst. of Applied Geophysics, Moscow); Koloskov, I. A.; Kuznetsova, V. M.; Tsybizov, I. S. Sov. Soil Sci. (Engl. Transl.); 4: No. 2, 193-201(1972).

Translated from Pochvovedeniye, No. 6, 66-75(1972).

The results of studies on the leaching rate of strontium-90 from soil by meltwater, rainwater, and ephemeral streams are analyzed. Experiments were performed under natural conditions on plots measuring 1 × 1 m to whose surface soluble strontium-90 compounds were applied previously. The coefficients of decontamination of the soil by surface water (ratio of the amount of strontium removed to the amount before leaching) were found to be close for the different kinds of surface water, averaging 0.62% a yr for soils contaminated 2 yrs and 0.16% a yr for soils contaminated 10 yrs. (auth)

12867 EFFECT OF HUMUS CONTENT AND COMPOSITION ON STRONTIUM-90 MOBILITY IN SOIL. Prokhorov, V. M.; Frid, A. S. (All-Union Inst. of Agricultural Physics, Moscow). Sov. Soil Sci. (Engl. Transl.); 4: No. 3, 333-340(1972).

Actual diffusivity (D) can be used as a measure of the mobility of an element in soil. An increase in the content of humic substances was found to reduce the D of strontium-90. Humic and fulvic acid salts have a greater effect on this parameter than do the acids themselves; the effect of humic acids and their salts is greater than that of fulvic acids and their salts. In natural soils, the D of strontium-90 may differ more than 70 times, depending on the composition and content of humic substances. (auth)

Water

Refer also to abstract 13089.

12868 (LA-5282-MS) ECOLOGICAL INVESTIGATION OF RADIOACTIVE MATERIALS IN WASTE DISCHARGE AREAS AT LOS ALAMOS FOR THE PERIOD JULY 1, 1972–MARCH 31, 1973. Hakonson, T. E.; Nyhan, J. W.; Johnson, L. J.; Bostick, K. V. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 48p. Dep. NTIS $4.00.

The ecological research program at the Los Alamos Scientific Laboratory is described and, in addition, the progress made on current project activities between July 1, 1972, and March 31, 1973 is summarized. Information is presented on: an environmental inventory of the Los Alamos area; a radionuclide inventory in three liquid waste disposal areas; studies to determine the applicability of the honeybee as an indicator of environmental radiocontamination; and a 27-year post-shot resurvey of the Trinity area to determine the bioavailability of the plutonium from the world's first nuclear detonation. Samples of soil, vegetation, rodents, turtles, insects, rabbits, and snakes were analyzed for ^{137}Cs, ^{60}Co, ^{90}Sr, ^{90}Y, ^{133}Ba, ^{152}Eu, ^{155}Eu, ^{241}Am, ^{238}Pu, and ^{239}Pu. (CH)

12869 POSSIBLE EFFECTS OF IONIZING RADIATION ON MARINE LIFE AND THE SUBSEQUENT IMPACT ON MAN. Moscati, A. F.; Erdmann, R. C. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 18-19 (1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Ecosystems and Food Cycles

12870 (TID-26343) OCCURRENCE OF ^{137}Cs IN THE BIOSPHERE EVALUATED WITH ENVIRONMENTAL AND METABOLIC STUDIES. Hasanen, E. (Helsinki Univ. (Finland). Dept. of Radiochemistry). May 1972. Contract AT(30-1)-3446. 119p. Dep. NTIS $8.00.

Studies on the changes in the ^{137}Cs levels in different environmental samples and in man following the second nuclear testing period in 1961 and 1962 are presented. Emphasis is placed on the ^{137}Cs levels in the reindeer-lichen-man food chain and in the aquatic food chains. The biological half-life of ^{137}Cs in man and in certain fish species is also presented. The radiation risk from ^{137}Cs to the population of Finland is briefly discussed. (ERB)

12871 RADIONUCLIDES IN FOODS. Washington, DC; National Academy of Sciences-National Research Council (1973). 95p. (COD-3167-58).

The subject of radionuclide contamination of food and water is discussed under the following headings: natural radionuclides in food and water; man-made radionuclides in food and water; quantitation of γ-emitting radionuclides in food; sources of radionuclide contamination and fusion reactors; control measures; and food irradiation. (ERB)

Radiometric Techniques

12872 THERMOLUMINESCENCE DOSIMETRY IN ARCHAEOLOGICAL DATING. Aitken, M. J.; Fleming, S. J. (Oxford Univ.). pp 1-78 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

Topics include basic concepts in thermoluminescence dating, thermoluminescence and other characteristics of pottery minerals, the microdosimetry of pottery, phosphor dosimetry as applied to pottery, and the recently developed pre-dose technique for dating pottery (instead of accumulated thermoluminescence, the change in thermoluminescence sensitivity of the 110°C peak in quartz is used as a measure of dose). (90 references) (WHK)

Site Surveys

Refer also to abstracts 14859, 14860, 14875–14878, 14907, 14931, and 14979.

12873 (BMI-171-149) AMCHITKA BIOENVIRONMENTAL PROGRAM. Studies of the Avifauna on Amchitka Island, Alaska. Annual Progress Report, July 1, 1971–June 30, 1972. Williamson, F. S. L.; White, C. M.; Emison, W. B. (Smithsonian Institution, Edgewater, Md. (USA). Chesapeake Bay Center for Field Biology). Apr 1973. Contract AT(26-1)-171. 22p. Dep. NTIS $3.00.

For Battelle Columbus Labs., Ohio.

No changes from previous years in bird species present or in their ecological or geographical distribution were observed during the study period, July 1, 1971 through June 30, 1972. Summer and winter populations of birds on Amchitka showed no change from previous years with the exception of an increase in the num-

ber of nesting bald eagles. No long-term effects of Milrow Event were detected. Cannikin resulted in the known test-related deaths of 17 birds, the loss of two peregrine falcon eyries, and the loss of four bald eagle eyries. At the same time it appears likely that new nesting habitat for some species of small sea birds was cre ated by Cannikin-induced rockfalls along the Bering Sea coast. (auth)

12874 (BNWL-1739) HANFORD WELLS. Kipp, K. L.; McGhan, V. L.; Damschen, D. W. (Battelle Pacific Northwest Lab., Richland, Wash.). Jun 1973. Contract AT(45-1)-1830. 115p. Dep. NTIS $7.75.

Data are presented on the location, size, depth, and condition of about 1300 wells at on-site and off-site locations in the Hanford Project area. (ERB)

12875 (DOCKET-700364-2) NUMEC TYPE II FACILITY. Environmental Report. (Nuclear Materials and Equipment Corp., Apollo, PA). 5 Mar 1973. 271p. Dep. NTIS $15.75.

An environmental report is presented for the transferring of fuel fabrication facility from Apollo, Pennsylvania to Parks Township, Pennsylvania. Topics considered include the site, the plant, environmental effects of site preparation, plant and transmission facilities construction, environmental effects of plant operation, effluent and environmental measurements and monitoring programs, environmental effects of accidents, economic and social effects of plant construction and operation, alternative courses of action and sites, plant design alternatives, summary benefit-cost analysis, and environmental approvals and consultation. (DHM)

12876 (DOCKET-700371-1) NAVAL PRODUCTS DIVISION. Environmental Report. (United Nuclear Corp., Montville, Conn. (USA)). 21 Feb 1973. 427p. Dep. NTIS $23.50.

An environmental report is presented for the consolidation of United Nuclear Corporation's fuel fabrication plant at New Haven, Connecticut with the Montville, Connecticut operation. Topics included are: Montville site, environmental effects of site preparation and plant construction, UNC expanded and consolidated fuel fabrication and core assembly plant, environmental effects of plant operation, environmental effects of accidents, unavoidable effects of plant expansion and operation, alternative to expansion and operation of the plant, long-term effects of plant expansion and operation, resources committed in plant expansion of operation, benefit cost analysis, and environmental approvals and consultations. (DHM)

12877 (DPSPU-73-30-1) ENVIRONMENTAL MONITORING IN THE VICINITY OF THE SAVANNAH RIVER PLANT. Annual Report for 1972. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). 1973. 27p. Dep. NTIS $3.50.

A continuous monitoring program has been maintained since 1951 (before plant startup) to determine the concentrations of radioactive materials in a 1200-square mile area outside the Savannah River Plant. The quantity of radioactivity released by SRP to its environs during 1972 was, for the most part, too small to be distinguished from natural background radiation and fallout from worldwide nuclear weapons tests. Tritium, cesium-137, and strontium-90 are the only radionuclides of plant origin detectable in river water. None of these had an average concentration that exceeded 0.2% of the Concentration Guide in river water sampled 8 miles downstream from the plant. Various water-quality analyses of river water samples indicated that Savannah River water is not adversely affected by SRP operations. (CH)

12878 (ORNL-TM-4185) INTAKE: A NUMERICAL PROGRAM TO CALCULATE FLUID VELOCITY PROFILES NEAR A RECTANGULAR INLET IN A STREAM WITH CROSS FLOW. Dresner, L.; Cain, V. R.; Davis, W. Jr. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 75p. Dep. NTIS $3.00.

A conversational program named INTAKE for the PDP-10 Timesharing System is described. INTAKE calculates fluid flow streamlines near a rectangular intake in a uniformly deep stream with uniform flow. It may be used to estimate the entrainment of nonuniformly distributed plankton by the intake. The program produces isometric projections of selected streamlines on the Calcomp curve plotter. The theory of the computation is based on potential flow and is fully described. Detailed instructions for operating the program are given. Illustrative results are exhibited and discussed. (auth)

12879 (USGS-474-103) HYDRAULIC TESTS IN HOLE UAe-2, AMCHITKA ISLAND, ALASKA. Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). Jun 1973. Contract AT(29-2)-474. 38p. Dep. NTIS $4.00.

Hydraulic testing and water sampling in hole UAe-2 were done during November and December 1967 and January 1968 to supplement and improve knowledge of the hydrology of Amchitka Island. Data are presented on well construction, hydraulic-testing procedures, and results of hydraulic-testing. (CH)

Thermal Effluents

Refer also to abstracts 14598, 14650, 14660–14664, and 15153.

12880 (BNWL-SA-4613) PRELIMINARY STUDIES ON THE RESISTANCE OF THE CRAYFISH, PACIFASTICUS LENIUSCULUS, TO ACUTE THERMAL SHOCK. Becker, C. D.; Genoway, R. G. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. Contract AT(45-1)-1830. 10p. (CONF-730505-4). Dep. NTIS $3.00.

From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

Laboratory studies were conducted to determine the resistance of the crayfish Pacifasticus leniusculus (Dana) to acute thermal shock after acclimation to 10, 20, and 30°C. Responses of crayfish from two allopatric populations in eastern Washington were compared. Slope and spacing of regression lines based on geometric mean times-to-death illustrate the established concept that acclimation to warmer thermal regimes will raise the ultimate incipient lethal level of a cold-blooded animal. P. leniusculus can survive an abrupt exposure (for 48 hours) to elevated temperatures up to about ΔT 19°C when acclimated to 10°C, about ΔT 10°C when acclimated to 20°C, and about ΔT 1–2°C when acclimated to 30°C. The ultimate incipient lethal level is probably close to 32 to 33°C. (auth)

12881 SIMPLIFIED METHOD FOR MEASURING TURBULENT DIFFUSIVITIES NEAR POWER PLANT DISCHARGES. Leribaux, H. R.; Lopez, F. Jr.; Djuric, D. (Texas A and M Univ., College Station). Trans. Amer. Nucl. Soc.; 16: 36-37(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12882 MAN'S IMPACT ON ENVIRONMENT. Detwyler, T. R. McGraw-Hill Series in Geography. New York; McGraw-Hill Book Company (1971). 743p. $6.95.

Fifty-two selections are presented in ten parts dealing with man's impact on the environment. An abstract was prepared for the selection on thermal pollution from the part dealing with man's impact on the waters. Other parts included selections on the basic causes of the present dilemma; impacts on atmosphere, climate, land, and soils; the spread of organisms, destruction of vegetation, and destruction and extinction of animals by man; and man as a maker of new plants and animals. (JCW)

For abstract of the individual paper see: 12883.

12883 THERMAL POLLUTION. Cole, L. C. (Cornell Univ., Ithaca, NY). pp 217-224 of Man's Impact on Environment. Detwyler, T. R. New York; Mdgraw-Hill Book Company (1971).

Thermal pollution evolved from the great demand for energy is examined. Ecological problems arise from the unrestrained growth of the human populations and the resultant increasing strains placed on Earth's life support systems. With the advent of the nuclear age, energy must be reradiated to space. In the past the Earth has stored some of the energy coming to it from the outside. This was accomplished by living plants using solar energy to drive endothermic chemical reactions, thereby creating organic compounds some of which were ultimately deposited in sediments. The process protected the organic compounds from oxidation and created a reservoir of oxygen in the atmosphere and eliminated the necessity for reradiating to space the heat energy that would have been released by the oxidation of those compounds. (JCW)

12884 STATISTICAL OPTIMIZATION OF DESIGN CONDITIONS FOR A THERMAL DISCHARGE DIFFUSER. Pease, T. E.; Skelly, M. J. (Quirk, Lawler, and Matusky Engineers, Tappan, NY). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 17(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

12885 PRELIMINARY MEASUREMENTS OF OVER-OCEAN ATMOSPHERIC DIFFUSION. Michael, P.; Raynor, G. S.; Brown, R. M. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 17-18(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Chemical Effluents

Refer also to abstracts 12852, 12853, 12877, 12882, and 15169.

12886 (ORNL-TM-4142) COST ESTIMATE FOR THE LIMESTONE WET SCRUBBING SULFUR OXIDE CONTROL PROCESS. Meyers, M. L. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 84p. Dep. NTIS $6.25.

A cost model for a commercially available full-scale sulfur oxide control process is presented for use in the Oak Ridge National Laboratory CONCEPT II computer code. Stack gases from a coal-fired and from an oil-fired plant are treated similarly by limestone in the wet scrubbing process. Included are mid-1972 costs at the subaccount levels for equipment, site labor, and materials, as well as the bases for estimating the various accounts and the special information related to making the estimates. Operating and maintenance costs are also estimated. (auth)

12887 INTERNALIZING THE MORTALITY COSTS OF AIR POLLUTION FOR THE ELECTRIC POWER INDUSTRY. Rogers, V. C. (Brigham Young Univ., Provo, UT); Sandquist, G. M.; Foster, G. R. Trans. Amer. Nucl. Soc.; 16: 41(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 12863 and 13405.

12888 USE OF PARTICLE CHANNELING IN TOF FISSION FRAGMENTS MEASUREMENTS. Wehring, B. W. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 16: 55(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

General Detectors and Monitors

Refer also to abstracts 12619, 14419, and 14420.

12889 (UCRL-51362) RESULTS OF THE 1972 SURVEY ON TRACK REGISTRATION. Griffith, R. V. (California Univ., Livermore. Lawrence Livermore Lab.). 15 Mar 1973. Contract W-7405-Eng-48. 105p. Dep. NTIS $5.45.
The results of a survey of 118 laboratory groups in 20 countries on the registration of particles in dielectric materials is presented. The survey includes data on track registration applications, as well as materials used, particles studied, analyses performed, and methods of data acquisition and track image enhancement. A section is also included which presents detailed replies by 39 laboratories on techniques of spark counting. (auth)

12890 INSTRUMENTS, DETECTION, AND ANALYTICAL APPLICATIONS FOR ISOTOPES. Managan, W. W. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 52(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12891 RADIATION INTERVALS DISTRIBUTION MEASUREMENT. Gat, U. (Univ. of Kentucky, Lexington). Trans. Amer. Nucl. Soc.; 16: 57-58(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12892 GAS-LOSS-COMPENSATED FISSION CHAMBER. Dayal, Y.; Neissel, J. P. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 258-259(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12893 MEASUREMENT OF HEAVY IONS USING SOLID-STATE GLASS DETECTORS. Siegert, G.; Fiedler, G.; Aschenbach, J. (Univ., Giessen, Ger.). Z. Naturforsch., A; 28: No. 3-4, 544-545(1973). (In German).
A simple model for track formation in solid state nuclear track detectors is proposed. According to this model the area of an etch pit is proportional to the etching time and to the square root of the energy of the impinging particle. This conclusion is in agreement with experimental results. (GE)

12894 HUMIDITY EFFECTS IN THE 1383A IONIZATION CHAMBER. Woods, M. J. (National Physical Lab., Teddington, Eng.). Nucl. Instrum. Methods; 109: No. 3, 615-616(1973).
The effect of variation of humidity on the response of the 1383A ionization chamber was investigated and found to be negligible. (auth)

12895 DETERMINATION OF GOLD-LAYER AND DEAD-LAYER THICKNESSES FOR A Si(Li) DETECTOR. Musket, R. G.; Bauer, W. (Sandia Labs., Livermore, CA). Nucl. Instrum. Methods; 109: No. 3, 593-595(1973).
Proton-induced $C(K_\alpha)$ and $O(K_\alpha)$ x-rays have been used to determine the efficiencies for detection of these x-rays by a Si(Li) detector. The efficiencies permitted evaluation of the effective gold-layer and dead-layer thicknesses for the detector. (auth)

12896 FABRICATION OF RADIAL POSITION SENSITIVE DETECTORS BY ION IMPLANTATION. Feuerstein, A.; Kalibitzer, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Instrum. Methods; 109: No. 3, 601(1973).
Radial position sensitive detectors have been fabricated by using ion implantation techniques for doping and metallizing silicon wafers. Position resolutions of 0.1 mm have been obtained with 5.5 MeV α-particles. (auth)

12897 LOCALIZATION OF THE POSITION OF THE PARTICLE ALONG THE WIRE OF A MULTIWIRE PROPORTIONAL CHAMBER. Foeth, H.; Hammarstrom, R.; Rubbia, C. (Technischen Hochschule, Achen). Nucl. Instrum. Methods; 109: No. 3, 521-524 (1973).
A method is discussed which is capable of an accurate localization of the position of the particle impact along each wire of a standard multiwire proportional chamber. The method is useful in cases in which the correct pair(s) of coordinates (x,y) for each (of many) particle(s) are directly required from a single gap. Applications are discussed: (1) the correct pairing (x,y) in the case of very many particles incident at the same time on a chamber; (2) a cylindrical wire chamber for large acceptance, many-particle solenoidal spectrometers; and (3) detection of both coordinates for low-energy γ-rays, for instance in medical applications. (auth)

12898 IMPORTANT PRECAUTION IN THE ETCHING OF SOLID STATE NUCLEAR TRACK DETECTORS. Khan, H. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 109: No. 3, 515-519(1973).
The effects of etch product layer on (a) the etch pit diameter and (b) the general etching velocity, V_g, have been studied in a number of Solid State Nuclear Track Detectors. Observations were made under various etching conditions and attempts were made to reduce the adverse effects of the etched product layer. The results show that (a) the effect of the etch product formation is more serious in the case of oblique tracks (as compared with perpendicular or near perpendicular ones) and (b) the method of mechanical brushing of the detector surface during the etching process is quite effective in removing this layer. (auth)

12899 RESOLUTION IN EXPERIMENTS OF ANGULAR CORRELATION OF ANNIHILATION PHOTONS. Poletti, G. (CISE, Milan); Rossito, F. Nucl. Instrum. Methods; 109: No. 3, 557-563(1973).
The overall resolution function for angular correlation devices is evaluated, removing the point source approximations. The non-uniform intensity distribution in the source is taken into account. The impact of the resolution on the features of the recorded angular correlation curves is discussed, with reference to the electron–positron system annihilation. (auth)

12900 LOW-LEVEL DETECTOR FOR ALPHA CONTAMINATION MONITOR IN CONTINUOUSLY FLOWING PROCESS WASTE WATER. Chiles, M. M. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 109: No. 3, 541-546(1973).
A low-level alpha detector was designed and developed for monitoring waste water continuously flowing from radiochemical processing plants and other facilities to determine whether these discharges contain alpha contamination. This detector enables constant and automatic monitoring, with actuation of an alarm signal immediately on detection of alpha contamination. The alpha particles are detected by a 6″ diam zinc sulfide scintillator, and the light flashes from the scintillator are detected by a 2 diam photomultiplier tube. The alpha sensitivity of the detector is $\approx 1 \times 10^{-9}$ Ci/ml of ^{238}U. Ten units have been fabricated and placed in service at Oak Ridge National Laboratory. (auth)

12901 BLACK NEUTRON DETECTOR. Poenitz, W. P. (Agronne National Lab., IL). Nucl. Instrum. Methods; 109: No. 3, 413-420(1973).
A fast time-response detector for absolute neutron flux measurements was designed. The detector consists of a medium size liquid scintillator tank with an entrance channel for a collimated neutron beam. The primary neutron energy is transformed by successive collisions into proton and carbon recoils resulting in a light flash which is detected by photo-multipliers at the surface of the scintillator volume. A favorable pulse height distribution is obtained with an additive device. The parametric dependence of the detection efficiency was studied using the Monte Carlo technique. A detector with a favorable set of parameters was built and checked experimentally. The evaluations and tests show this "Black Neutron Detector" to be a good instrument for precise absolute neutron flux measurements in the MeV energy region. (auth)

12902 PROPORTIONAL CHAMBERS WITH MONOFILAR HELICAL CATHODES FOR HIGH SPATIAL RESOLUTION. Lee, D. M. (Univ. of Virginia, Charlottesville); Sobottka, S. E.; Thiessen, H. A. Nucl. Instrum. Methods; 109: No. 3, 421-428 (1973).
Multiwire proportional chambers with monofilar helical delay line cathodes have been developed. Spatial resolutions better than 0.33 mm fwhm have been achieved. Such chambers are easily constructed and read out and can be adapted to a large variety of geometries. The properties of monofilar helical delay lines are analyzed in detail. (auth)

12903 MONITOR FOR THE MEASUREMENT OF RADON IN MINE ATMOSPHERES. Strong, J. C.; Duggan, M. J. (National

Radiological Protection Board, Sutton, Eng.). Ann. Occup. Hyg.; 16: No. 1, 27-31(Apr 1973).

A radon monitor based on the two-filter method, and which measures the concentration during sampling, is described. The monitor is sufficiently large for use in mines and is capable of measuring concentrations down to about 10 pCi/l within a few minutes. (auth)

12904 RADIATION MONITORING: METHODS AND INSTRUMENTS. Part 1. Monitoring Tasks and Problems. Bullen, M. A. (Bristol General Hospital, Eng.); Garrett, J. A. Bio. Med. Eng.; 8: No. 5, 198-201(May 1973).

A brief outline survey is made of radiation monitoring, taken in this case to include those radiation detection activities requiring accuracies no better than ±10%. The subject is dealt with under the following headings: (a) classification of monitoring activities, qualitative and quantitative; (b) basic physical concepts and units of measurement; (c) recommendations and legislation; and (d) monitor response, including energy dependence of response, radiation selectivity and calibration. (UK)

12905 VARIABILITY OF PLATEAU GRADIENTS FOR LARGE-DIAMETER END-WINDOW GEIGER–MUELLER TUBES. Bush, D. (Univ. of Birmingham, Eng.). J. Phys., E (London); 6: No. 6, 561-563(Jun 1973).

Manufacturers of Geiger–Mueller tubes usually quote a maximum value of plateau gradient for a tube. This might lead users to expect that, within the accepted range of application of these tubes, the plateau gradient is effectively constant and the stated maximum value will not be exceeded. Measurements of plateau gradients for 5 cm diameter end-window GM tubes have shown that the gradients are dependent on the type and energy of the radiation and on the count rate. Also the specified maximum value of plateau gradient has been exceeded under conditions encountered in normal use. Results are presented which illustrate these effects, and the probable causes and practical significance of these effects are discussed. (auth)

12906 WINDOWLESS 4π-SCINTILLATION COUNTER WITH NaI(Tl) CRYSTALS. Plch, J.; Zderadicka, J.; Kokta, L. (Ustav pro Vyzkum, Vyrobu a Vyuzitu Radioisotopu, Prague). Int. J. Appl. Radiat. Isotop.; 24: No. 7, 407-413(Jul 1973).

A 4π-scintillation counter with two NaI(Tl) crystals of 4.4 cm diameter and 2 cm height is described. A solid source, mounted as a sandwich between polyethylene foils, is inserted between the crystals. The efficiency for γ-ray detection is higher than 97% in the region from 20 to 160 keV when 20 mg/cm^2 foil is used. The counter has good resolution and low noise. When the emission rate of 22- and 136-keV photons is measured the accuracy is estimated as ±0.3%, and in the case of the 22-keV photons ±0.25%. (auth)

12907 DEAD TIME, DECAY, AND BACKGROUND EFFECTS IN COUNTING. Baerg, A. P. (National Research Council of Canada, Ottawa). Int. J. Appl. Radiat. Isotop.; 24: No. 7, 401-405(Jul 1973).

The combined effects of background, decay, and dead time losses in counting are considered, particularly as they relate to the variance of the measure of the true counting rate. Expressions are given for the variances attached to the several components in coincidence counting. (auth)

12908 VACUUM CHAMBERS FOR RADIATION MEASUREMENT. Burlin, T. E. (Polytechnic of Central London, London). pp 143-220 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

Topics include secondary electron emission phenomena, Greening's theory of the vacuum chamber, vacuum chambers as dosimeters, vacuum chambers as electron-beam monitors, vacuum chambers for pulse measurements, vacuum chambers as energy spectrometers, and vacuum chambers for interface dosimetry. (155 references) (WHK)

12909 REVERSIBLE PULSE HEIGHT VARIATIONS OF RELEASE COUNTERS. Glaeser, M.; Heise, V. (Paedagogische Hochschule, Potsdam, Ger.). Isotopenpraxis; 8: No. 11-12, 464-467(1972). (In German).

In counter tubes with organic quenching agents, it was observed that the pulse height decreased gradually throughout a period of time up to one hour after start of the stabilized voltage. The reversible pulse height changes represented a hysteresis effect. Insulation, adsorption, and surface charges were studied but could not be identified unequivocally as sources for the effect. The degree of pulse height change depended on the type of counter tube. (HBG)

12910 DEVICE FOR THE QUANTITATIVE DETERMINATION OF THE RADIOACTIVE CONTAMINATION OF SURFACES. Fauchille, J. P. P. (to Societe Kodak-Pathe). French Patent 2,128,055. 20 Oct 1972. Filed date 2 Mar 1971. 8p. (In French).

A device for the determination of low-energy radiations or particles is presented. It consists of a stage provided with a circular orifice mounted on a cylinder closed at its upper end and possessing a shutter that slides perpendicular to the axis of the stage (the stage, the cylinder, and the shutter when in the closed position form a light-tight enclosure) and a film holder positioned in the enclosure at the lower end of a cylindrical block which slides in the hollow cylinder. The film holder supports a photosensitive film consisting of a layer of silver halide emulsion sedimented or centrifuged on a substrate. It is also provided with two lateral flanges resting on the shutter in such a way that the distance separating the photosensitive surface and the shutter surface is determined by the thickness of the material from which the film holder is made and that the photosensitive surface is parallel to the surface of the shutter. The shutter enables the film holder and the photosensitive film to be released so that the photosensitive film presses against the surface of the emitting material positioned in the orifice of the stage, the photosensitive surface being parallel to the emitting surface which is situated at a constant distance from it. This distance is determined by the thickness of the material from which the film holder is constructed. (FR)

Radiation Dosimeters

12911 (ANL-7970, pp 9-11) NEUTRON DOSIMETRY FOR THE JANUS PROGRAM. Williamson, F. S.; Frigerio, N. A.; Holmblad, G. L.; Trier, J. E.; Johnson, E. G. Jr. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Neutron dosimetry in the JANUS High Flux Room to determine if the neutron spectrum variations will lead to significant dose-response relationships in the irradiated biological system is described. Two ionization chambers of 0.05 ml, one with A150 plastic walls and electrodes and TE gas filling, the other with magnesium walls and electrodes and argon filling, were used in a mouse phantom made of A150 Shonka tissue-equivalent plastic. Preliminary data indicate there will be no significant variation of depth-dose distribution in mice due to spectrum variation in the JM-2 experiment. (WHK)

12912 (CEA-R–4009(1)(2nd. Ed.)) NORMALIZATION OF THE PHYSICAL TESTS FOR EXTERNAL IRRADIATION MEASURING DETECTORS. Part I. Detectors Measuring External Irradiation Due to Electromagnetic Radiation. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1973. 51p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

Standardization work carried out in the Radiation Protection Service of the CEA and physical tests performed on external radiation measuring detectors are presented. Various tests are discussed. Detailed information is given on the calibration and the determination of the relative spectral sensitivity. In the calibration, standardization involves the reference detector, the reference source, the installation and calibration procedures. In the determination of the spectral response, standardization involves the reference detector and the radiation source used. High flux detectors and pulsed electromagnetic radiation detectors are presented. (FR)

12913 (COO-323-30) SPECIAL PROBLEMS IN NUCLEAR INSTRUMENTATION. Progress Report, June 1, 1972–May 31, 1973. Spokas, J. J. (Illinois Benedictine Coll., Lisle (USA). Physical Science Lab.). 30 May 1973. Contract AT(11-1)-323. 25p. Dep. NTIS $3.25.

The design and performance of three small thimble ionization chambers (one of a muscle-equivalent plastic, one of magnesium, and one of an air-equivalent conducting plastic); the development and operation of a spherical 16-liter muscle-equivalent ionization chamber for environmental monitoring; and research on Shonka–Wyckoff transfer chambers for use as a secondary standard for exposure measurement are described. (WDK)

12914 DIFFUSION CHAMBER RADON DOSIMETER FOR USE IN MINE ENVIRONMENT. Frank, A. L.; Benton, E. V. (Univ. of San Francisco). Nucl. Instrum. Methods; 109: No. 3, 537-539(1973).

A diffusion chamber dosimeter for measurement of radon gas exposure in a mine environment was developed and tested. This dosimeter is a small rugged device of simple design. It can be conveniently and economically utilized by miners. Cellulose nitrate plastic track detectors are used to measure the ^{3}He-particle emissions resulting from ^{222}Rn decay. Calibrations were made for a series of exposure times in a laboratory chamber containing measured concentrations of radon gas. The time-

averaged response was found to rise for short exposure times due to the slow dissipation of radon from the sensitive volume of the diffusion chamber. For longer exposure times the response is flat. The measured response varied from a high of 0.0654 ± 0.0033 tracks/cm^2 per pCi-h/l for shortest exposure time of 0.5 h, to 0.0431 ± 0.0005 for longest exposure time of 8 h. The decrease after exposure times of 2h is about 14%. (auth)

12915 G-VALUE FOR THE FERROUS SULPHATE DOSEMETER FOR 14 MeV NEUTRONS. Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.); Law, J. Phys. Med. Biol.; 18: No. 3, 369-378(May 1973).

The $FeSO_4$ G-value for a therapy beam of 14-MeV neutrons from a DT generator has been measured, using a polythene-ethylene ion chamber for basic dosimetry. The result for the mixed neutron plus γ-ray beam was 9.8 ± 0.6, and after correction for the measured 15% γ-ray component the G-value for the neutron component alone was 8.9 ± 0.6. Dose rates were between 10 and 20 rad min^{-1} and total doses between 200 and 600 rad. The random uncertainty in the experimental observations at these low dose levels was only about 1%, the principal source of error in the final result being the uncertainty in the basic neutron dosimetry. (auth)

12916 MEASUREMENT OF FAST NEUTRONS PRODUCED BY HIGH ENERGY X-RAY BEAMS OF MEDICAL ELECTRON ACCELERATORS. Wilenzick, R. M.; Almond, P. R.; Oliver, G. D.; De Almeida, C. E. (Univ. of Texas, Houston). Phys. Med. Biol.; 18: No. 3, 396-408(May 1973).

The fast neutron contamination associated with the 25 MV x-ray beam of a clinical linear accelerator and with the 19 MV x-ray beam of a betatron has been measured at the patient treatment location, using both fission fragment track detectors and silicon diode dosemeters. Measurements were made of the neutron fluence and dose, both in and out of the primary photon beam, at distances up to 60 cm from the central axis. Neutron distributions were similar for the linac and the betatron, with approximately ten times greater neutron dose in the x-ray field than at 20 cm outside it. For a linac field of 10 × 10 cm at a distance of 1 m from the target, the neutron dose in the field was 0.54 ± 0.05% of the x-ray dose; the corresponding value for a 7.6 × 11.4 cm betatron field at 50 cm was 0.22 ± 0.03%. The silicon diodes were preferred over track detectors for measurements of fast neutrons in intense high-energy photon fields. (auth)

12917 FARMER DOSEMETER MODIFICATIONS. Part 1. Elimination of Grid Bias Batteries. Part 2. Improvement of Compensate Network. Arkley, W. (Univ. of Newcastle upon Tyne, Eng.). Brit. J. Radiol.; 46: No. 546, 478-480(Jun 1973).

A circuit diagram is given for a Mark 2 Farmer dosemeter, modified to enable the original grid bias batteries to be replaced by readily available 9 volt batteries. Another simple modification is made which allows the zero drift compensate network to be adjusted, so that it works correctly with any length of capacitance of cable fitted to the instrument. Instructions for the correct adjustment of this new compensate network are given. (UK)

12918 THERMALLY STIMULATED CURRENT IN TISSUE-EQUIVALENT MATERIALS FOR RADIATION DOSIMETRY. A Preliminary Assessment. Harper, M. W. (Velindre Hospital, Cardiff, Wales); Thomas, B. Phys. Med. Biol.; 18: No. 3, 409-420(May 1973).

Low atomic number insulators have been assessed for their suitability as integrating dosemeters in which dose is read by measuring thermally stimulated currents. The dosemeter is heated while an electric field is applied and the total charge collected is related to radiation dose. Factors considered in the initial selection of materials are the availability of reproducible batches and the inherent conductivity of the dosemeter, tissue equivalence and response per rad. A TPX polymer shows the greatest potential so far. Preliminary measurements indicate a useful response to doses beyond 20 krad, a standard deviation on 10 consecutive readings of 1.3%, and fading of 24% in 60 h. The simple reading apparatus is a unique advantage of the system. (auth)

12919 COMPARISONS OF RADIATION DOSIMETRY. Law, J. (Royal Infirmary, Edinburgh); Svensson, H. Phys. Med. Biol.; 18: No. 3, 464-465(May 1973).

A brief note is made of the results of direct comparisons of the response of $FeSO_4$ dosemeter solutions from Umea (Sweden) and Edinburgh (UK). Irradiations of solutions in Umea in polystyrene vessels, using ^{60}Co radiation, gave a ratio of Umea in Edinburgh solution response of 0.996 ± 0.002. Irradiations in Edinburgh in glass bottles, also with ^{60}Co irradiation, gave a value of 0.996 ± 0.004 for that ratio. These results are discussed in the light of previously reported comparisons of radiation dosimetry in Houston and Washington, USA, Edinburgh and Umea. (Ehrlich, M. and Lamperti, P. J. Phys. Med. Biol. 14, 305(1969)). It is pointed out that it appears that with reasonable care in preparation, dosemeter solutions from many centres agree in their radiation response to within ±1%. (UK)

12920 TLD SYSTEM FOR RADIOTHERAPY MONITORING. Dalgleish, J. (Hull Royal Infirmary, Eng.). Phys. Med. Biol.; 18: No. 3, 465-467(May 1973).

A preliminary note is presented on work of Hull, U. K., to produce a system of thermoluminescence dosimetry for radiotherapy monitoring, using LiF-7 Teflon microrod dosemeters with a Teledyne 7300 reader. The microrods, though supplied as disposable, were checked over a series of exposures. Twenty dosemeters, taken randomly from a batch of 100, simultaneously received 100 R of ^{60}Co γ-rays. Excluding the first read-out, the standard deviation of the group sensitivity was 4.4%. The mean of the group sensitivity of the first 9 read-outs was 1.127 digits/r. A small positive correlation was observed between sensitivity and time between read-outs but no correlation was observed between sensitivity and time between irradiation and read-out. In further experiments, it appeared that 6 successive anneal cycles, immediately after read-out of a high dose (500 to 2000 R) restored the sensitivity. It was concluded that in any group of dosemeters there was a sensitivity range, the mean value of which was ±5% after an exposure of 100 R. Consequently each dosemeter should be calibrated and kept individually. If this is done, the sensitivity of disposable microrod dosemeters could be maintained over a series of at least 17 exposures typical of those received during radiotherapy treatment monitoring. (UK)

12921 SPECTROSCOPY OF SOME GAMMA SOURCES AND ITS APPLICATION IN THE COMPUTING OF THE GAMMA CONSTANT. Ninkovic, M. Belgrade; University of Belgrade (1971). vp. (In Slovak).

Thesis.

A study on gamma spectroscopy for gamma dose determination is presented. (WHK)

12922 TOPICS IN RADIATION DOSIMETRY. Attix, F. H. (Ed.). Radiation Dosimetry, Supplement 1. New York; Academic Press, Inc. (1972). 565p. $28.00.

A separate abstract was prepared for each of the eight sections in the book. (WHK)

For abstracts of individual sections see: 12872, 12908, and 12923–12928.

12923 DOSIMETRIC APPLICATIONS OF TRACK ETCHING. Becker, K. (Oak Ridge National Lab., TN). pp 79-142 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

Topics include damage mechanisms, latent track stability, etching procedures and detector materials, track counting, fission fragment registration, alpha particle and recoil nuclei registration, and outlook. (extensive list of references) (WHK)

12924 WALL-LESS DETECTORS IN MICRODOSIMETRY. Glass, W. A. (Battelle Pacific Northwest Lab., Richland, Wash.); Gross, W. A. pp 221-260 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

A wall-less proportional counter is a device which collects ionization from a small central region of a large gas volume by utilizing a minimum amount of structural material to greatly reduce the wall effects. Design criteria, operational characteristics, performance and operational tests, wall-less counter designs (field defined walls and grid defined walls), and experimental results are discussed in detail. (59 references) (WHK)

12925 DOSIMETRY OF LOW ENERGY X RAYS. Greening, J. R. (Royal Infirmary, Edinburgh). pp 261-315 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

The measurement of energy fluence including corrections for lack of total absorption, total absorption calorimetry, total absorption ionization chambers, total absorption silicon barrier layer devices, chemical dosimeters, and other total absorbing devices are discussed. The determination of absorbed dose by calorimetry, ionization methods, ferrous sulfate dosimetry, determination from measurement of energy fluence, and solid state methods were studied. Also, the x-ray spectral distribution, measurement of exposure, and special problems in the measurement of low-energy x rays are discussed. (118 references) (WHK)

12926 STRUCTURE OF PARTICLE TRACKS. Katz, R.; Sharma, S. C.; Homayoonfar, M. (Univ. of Nebraska, Lincoln). pp 317-383 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

The theory and general applicability of the δ-ray theory of

track effects to various systems are reviewed. The one-hit model of detector response is discussed and applied to several detectors including solid-state dosimeters (glass and LiF), dry solid biological substances, organic scintillators, and the ferrous sulfate dosimeter. The δ-ray theory of the inactivation of cells by monoenergetic heavy ions is presented, and the theory is extended to a general radiation environment. The result is then specialized to 14-MeV neutrons, to stopped negative pions, and to problems in heavy-ion cancer therapy. The new concept of radiation quality and a parameter through which it may be described are discussed. (58 references) (WHK)

12927 DOSE EQUIVALENT DETERMINATIONS IN NEUTRON FIELDS BY MEANS OF MODERATOR TECHNIQUES. Nachtigall, D. (Paedagogische Hochschule Ruhr, Dortmund, Ger.); Burger, G. pp 385-459 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

Topics include rem counter techniques (single-response devices and multiresponse devices); monitor techniques (devices with flat response per unit fluence, devices with arbitrary response, and determination of conversion factors); neutron spectrometry (general concept and calculation procedures); and calibration of instruments (neutron sources and neutron fields). (Extensive list of references) (WHK)

12928 DEVELOPMENTS IN RADIOPHOTOLUMINESCENCE DOSIMETRY. Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.). pp 461-532 of Topics in Radiation Dosimetry. Attix, F. H. (ed.). New York; Academic Press, Inc. (1972).

Topics include RPL centers and kinetic behavior of silver-activated phosphate glasses; new RPL materials (silver-activated phosphate glass, silver-activated lithium borate glass, and lithium fluoride); energy compensation filters; new measurement techniques; practical application of phosphate glass dosimeters (accuracy in routine personnel monitoring, long-term dose accumulation, dosimetry in mixed gamma and neutron fields, dosimetry at high dose levels, and dosimetry at elevated exposure temperatures); application of differential measurement of fluorescence intensity (determination of x-ray quality, measurement of x- or γ-ray exposure, and direction of radiation incidence); and dosimeters for direct indication of the absorbed dose in critical organs. (116 references) (WHK)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 13439 and 14007.

12929 (AAEC/TM-634) GAMMA RAY SPECTRA OF URANIUM AND THORIUM ORES BY HIGH RESOLUTION (Ge(Li)) SPECTROMETRY. Urquhart, D. F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

To assess the usefulness of high-resolution semi-conductor gamma-ray spectrometers for the analysis of radioactive minerals, a detailed study was made of the spectra from uranium and thorium ores using a Ge(Li) spectrometer. In conjunction with this, a detailed tabulation was made of the energies and intensities of all the known gamma-ray emissions from these minerals. This spectrometer was used to determine the uranium and thorium content of a formation in the Northern Territory containing very low levels of uranium and relatively high levels of thorium. The results obtained compared favourably with chemical analyses. Although the excellent resolution of this spectrometer is a great advantage to the study of complex spectra, the low efficiency, high cost and difficulty of operation preclude any likelihood of it replacing scintillation spectrometers for routine radiometric analysis of ores. (auth)

12930 (CEA-N-1578) COMPUTER CODE FOR PROCESSING THE AMPLITUDE HISTOGRAMS WITH GE-LI SEMICONDUCTORS: JONQUES PROGRAM. Panisset, J. C. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Mar 1973. 74p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

This code locates peaks and calculates their principal characteristics. It also enables the nuclides present to be identified and determined. The nuclear data concerning the nuclides are collected in a card-index system common to several CEA services. The composition expected is indicated above each spectrum. The expected nuclides are defined to be present if their most significant γ ray appears in the spectrum. All other nuclides can also be identified if their γ ray spectrum is observed. The program indicates all the ambiguities (interference of nuclides) and anomalies (nonattributed peaks) by considering all the γ emissions from predicted or possible nuclei. A synthesis of this information is provided by the plotters of the Computer Center. The nuclide activities are subsequently calculated with the possibility of selecting the lines used in the calculation for the different predicted nuclides. The efficiency of the detector is calculated for a standard spectrum, the determination or detection of impurities remaining possible under the previously defined conditions. (FR)

12931 (ITJ-37) PRECISION OF DIRECT METHODS OF PHOTOPEAK INTEGRATION IN CASES OF SLOPING BACKGROUND. Taczanowski, S. (Institute of Nuclear Techniques, Krakow (Poland)). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Generalizing modifications are suggested which improve the precision of Covell's, Sterlinski's and Wasson's methods in cases of sloping background. The inequality of the sides of a peak with respect to the information contained under these conditions is pointed out. Also the simplified version of Wasson's technique is proposed. (auth)

12932 OPERATING CHARACTERISTICS OF A LEAD SLOWING DOWN TIME SPECTROMETER FOR FISSILE MATERIAL ASSAY AND TIME DEPENDENT NEUTRON SLOWING DOWN STUDIES. Arwell, T. L.; Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 86-87(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12933 NEUTRON PULSE WIDTH EFFECTS IN THE LEAD SLOWING-DOWN-TIME SPECTROMETER. Rushton, J. E.; Sawan, M.; Conn, R. W.; Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 307-308(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12934 FAST-NEUTRON MEASUREMENTS IN SIMPLE LATTICES WITH A ^{3}He SPECTROMETER. Hughes, T. E. C.; Robeson, A. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Trans. Amer. Nucl. Soc.; 16: 308-309(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12935 NEUTRON SPECTRA MEASUREMENTS WITH MINIATURE NE-213 DETECTORS. Meyer, W. (Univ. of Missouri, Columbia); Prigel, D. W. Trans. Amer. Nucl. Soc.; 16: 361-362 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12936 REDUCTION OF NEUTRON-INDUCED BACKGROUND IN NaI γ RAY SPECTRA. Diener, E. M.; Chang, C. C. (Stanford Univ.). Nucl. Instrum. Methods; 109: No. 3, 585-588(1973).

The use of pulsed beam and time-of-flight techniques to suppress the neutron-induced background in NaI γ-ray spectra is described. Application to the study of the D(p, γ) ^{3}He reaction is presented as an example. (auth)

12937 NEW METHOD FOR REPRESENTATION OF THE DETECTION PEAKS OF A Ge(Li) DETECTOR. Libert, J. (Univ. de l'Etat a Mons, Mons, Belgium). Nucl. Instrum. Methods; 109: No. 3, 609-611(1973).

A new method for fitting Ge(Li) peaks is proposed (variable width Gaussian function-five parameters). (auth)

12938 MASS RESOLUTIONS IN FISSION-FRAGMENT DOUBLE-KINETIC ENERGY MEASUREMENTS. Bohn, E. M.; Lerche, R. A.; Long, A. B.; Wehring, B. W. (Univ. of Illinois, Urbana). Nucl. Instrum. Methods; 109: No. 3, 605-608(1973).

The width of the fission-fragment mass distribution at the 1%-yield was found to be useful in determining the system mass resolution. The relationship between the 1% width and mass resolution is presented for both thermal-neutron fission of ^{235}U and spontaneous fission of ^{252}Cf. (auth)

12939 CUTIPIE: A COMPUTER PROGRAM TO ANALYZE GAMMA-RAY SPECTRA. Teoh, W. (Univ. of Manitoba, Winnipeg, Canada). Nucl. Instrum. Methods; 109: No. 3, 509-513 (1973).

CUTIPIE is a computer program designed to determine accurately the positions and areas of photopeaks in gamma ray spectra taken with semi-conductor detectors. A new function representing the background is chosen, and is simultaneously fitted with the peak, the shape of which consists of a basic gaussian with an exponential tail on the low energy side. The program uses the numerical second difference method for automatic peak searching and the method of least squares for the peak fitting. An alternative simpler peak shape consisting of a gaussian distribution on a straight line background is also incorporated in the program for use with data of poorer statistical accuracy. Up to a maximum of six peaks can be unfolded from an overlapping group of lines by CUTIPIE. (auth)

12940 STANDARD SPETRUM METHOD FOR THE ANALYSIS OF GAMMA RAY SPECTRA FROM SEMICONDUCTOR DETECTORS. Tasaka, K. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 109: No. 3, 547-556(1973).

A new attempt is described to analyse the gamma-ray spectra by the least squares technique which uses a standard spectrum for the shape function so as to express the line shape accurately with a small number of parameters and to analyse complex overlapping peaks simultaneously. The standard spectrum is directly made from the observed spectrum, which corresponds to the incident monochromatic gamma-ray, through the subtraction of background gamma-rays and smoothing of the data. The peak component of each photopeak is given correctly for each channel by integrating the standard spectrum over the width of the channel in order to lessen the dependence of fitting results to the channel width of a pulse height analyser. It is confirmed that the complicated gamma-ray spectrum with multiple photopeaks can be fitted accurately to the standard spectrum and the linear background continuum by the present method. The effectiveness of integral representation for the peak component is also confirmed. (auth)

12941 DIRECT-READING ARITHMETIC UNIT FOR NONDESTRUCTIVE ASSAY OF NUCLEAR MATERIALS. Martin, E. R. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 109: No. 3, 439-444(1973).

For nuclear assay applications involving the generic calibration function $[k_1A - k_2B)/T] - k_3$, a new method of evaluating this function directly by simple circuitry as the data are received is described, together with detailed results of a prototype unit constructed for use with the "enrichment meter" used in passive gamma assay. (auth)

12942 DETECTION OF PROTON-INDUCED C(K) X-RAYS WITH Si(Li) DETECTORS. Musket, R. G.; Bauer, W. (Sandia Labs., Livermore, CA). Nucl. Instrum. Methods; 109: No. 3, 339-452(1973).

Proton-induced X-rays (PIX) have been shown to be valuable in investigations of semiconductor detector characteristics for detection of low energy X-rays. The major advantage of PIX over electron and X-ray excitation is the virtual absence of background radiation. For the detection of proton-induced $C(K_\alpha)$ X-rays by Si(Li) detectors, the influence of detector bias voltage and, hence, the applied electric field on the detector efficiency, the fraction of the X-ray energy detected and the width of the peak is presented. In addition, the Si(Li) detectors have been shown to exhibit a very linear relationship between X-ray energy and detector pulse-height down to X-ray energies of 277 eV [i.e., $C(K_\alpha)$ X-rays)]. (auth)

12943 TIME STRETCHER. Jones, R. E. H.; Wynroe, A. J. (Univ. of Manchester, Eng.). 109; 109: No. 3, 461-477(1973).

A system designed to replace the normal time to analogue converter/analogue to digital converter combinations used to record multichannel timing information in nuclear physics experiments is described. The Time Stretcher measures the time difference between START and STOP signals by charging a capacitor with a high current for this time interval; the charge is then held until the capacitor is subsequently discharged by a smaller current. The time required to remove the charge determines the length of the output pulse. The unit will accept time intervals from 5 to 120 ns, and has a stretch factor of 1000. Thus with an external 20 MHz clock and scaler the resolution when referred to the input is 50 ps per clock pulse. As the system operates on a dual slope principle, many of the usual sources of error are eliminated giving excellent integral and differential nonlinearity together with long term stability of a high order. The effects of leakage current in the integrator are reduced by a drift correction loop so that a delayed readout can be used. Details of the circuitry and the method of operation are given together with a discussion of the results obtained from various calibration and stability tests. (auth)

12944 PREAMPLIFIER NOISE IN PROPORTIONAL COUNTER MEASUREMENTS. Breyer, B. (Institut Rudjer Boskovic, Zagreb). Int. J. Appl. Radiat. Isotop.; 24: No. 7, 395-399(Jul 1973).

The influence of common pulse shaping networks used in low energy ionizing radiation spectroscopy on proportional counter pulse amplitudes and signal-to-noise ratios is considered. The optimum pulse shaping network for the measurement of pulse amplitudes from proportional counters in the presence of preamplifier noise is derived. The performance of simple RC filters and active "quasi Gaussian" filters are compared with the theoretically optimal network. (auth)

12945 CONSTRUCTION AND CALIBRATION OF A NEUTRON SPECTROMETER IN THE ENERGY RANGE OF 10 TO 50 MeV. Boehm, L.; Boehm, J.; Wibberenz, G. (Univ., Kiel). Atomkernenergie; 21: No. 1, 48-54(1973). (In German).

The construction and calibration of a neutron spectrometer for measuring solar neutrons is described. A simple circuit for electronic separation of gamma rays and neutrons is given. Inelastic interactions of neutrons >18 MeV with carbon atoms can no longer be neglected in the NE 213 scintillator used for neutron detection. (GE)

High Energy Physics Instrumentation

12946 (BNL-tr-527) TRANSITION EFFECT DUE TO IONIZATION LOSSES OF HIGH-ENERGY PARTICLES. Garibyan, G. M.; Ispiryan, K. A. Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 11, 586-588(1972). 6p. Dep. NTIS $3.00.

A mechanism is determined that would account for the decrease of the ionization losses of relativistic particles in proportional gas counters, and methods of reducing this effect are considered. (JFP)

12947 (COO-2232-4) LEAD-GLASS CHERENKOV DETECTOR FOR ELECTRONS AND PHOTONS. Beale, J. S.; Buesser, F. W.; Camilleri, L.; Di Lella, L.; Gladding, G.; Placci, A.; Pope, B. G.; Smith, A. M.; Smith, B.; Yoh, J. K.; Zavattini, E. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York; Rockefeller Univ., New York). 1973. 18p. (CONF-730531-5). Dep. NTIS $3.00.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

An apparatus for the detection of high-energy electrons and photons is described. Lead-glass Cherenkov counters measure the energies, and charged particle tracks are reconstructed using an array of wire spark chambers. The mode of operation, calibration, and stability of the system are described, and details are given of the ability to discriminate electrons from hadrons. (auth)

12948 (IPNO/HE-73-1) TRACK PARAMETRISATION IN THE INHOMOGENEOUS FIELD OF THE SPLIT FIELD MAGNET. Aubert, J. J.; Broll, C. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Since tracking charged particles through an inhomogeneous field consumes much computer time, another method was investigated for the CERN-Hamburg-Orday-Vienna experiment with the CERN Intersecting Storage Rings. This new method, based on polynomial representations, was shown to be sufficiently accurate and ten times faster than a standard tracking method. There is a possibility of extending this method to the whole split field magnetic detector system. (auth)

12949 (ORO-3065-28) PROGRESS REPORT, JULY 1, 1972-JUNE 30, 1973. Walker, W. D. (Duke Univ., Durham, N. C.). 1973. Contract AT(40-1)-3065. 7p. Dep. NTIS $3.00.

High-energy physics research at Duke University from July 1, 1972 through June 30, 1973, is outlined. Progress on RIPPLE for bubble chamber track analysis, the experiment at SLAC to study pion reactions with neon in the Ne-Hz filled bubble chamber, high-energy $\pi + \pi$ interactions, work on projection chambers, and collaboration with NAL are briefly discussed. (WHK)

12950 ENERGY DEPOSITION AND FLUCTUATION IN A LARGE ORGANIC SCINTILLATOR. Gabriel, T. A.; Amburgey, J. D. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 362-363(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12951 TOWARDS THE TRIGGERED BUBBLE CHAMBER. Rice-Evans, P. (Bedford Coll., London). Nucl. Instrum. Methods; 109: No. 3, 525-527(1973).

The fact that one cannot trigger bubble chambers is a serious disadvantage, and efforts should be made to overcome the handicap. The theory of bubble growth is reviewed and particular reference is made to the liquid xenon chamber. The recent technical development of streamer chambers is discussed and so also is the Berkeley invention of the liquid xenon proportional counter. It is tentatively suggested that it might be feasible to trigger the expansion mechanism immediately after a charged particle has passed through a xenon chamber, and then to supply the necessary energy for bubble formation, by causing avalanche multiplication at the moment of superheat with a pulsed electric field (derived from a Marx generator). A number of difficulties are discussed including the production of megavolt pulses, and the

handicap of electron diffusion. Double-pulsing—i.e., one Marx pulse applied at the moment of triggering, and another at superheat—might be necessary. (auth)

12952 COMPUTER PROGRAM TO CONTROL THE ELECTRONIC ACQUISITION OF DIGITIZED INFORMATION IN NUCLEAR EXPERIMENTS. ELAINE. Lowenstein, D. I. (Univ. of Pittsburgh). Nucl. Instrum. Methods; 109: No. 3, 589-591 (1973).

An on-line data acquisition computer program which has been designed to monitor and control experiments consisting of both magnetostrictive and multiwire proportional chambers, with data input rates of 20,000 words per second and more, is described. (WHK)

12953 BUBBLE NUCLEATION BY FAST-NEUTRON RECOIL ATOMS IN SUPERHEATED ETHYL ALCOHOL AND WATER. Pilati, D. A. Stanford Univ. (1973). 141p. University Microfilms Order No. 73-14,957.

Thesis (Ph. D.).

A study of bubble nucleation in superheated water and ethyl alcohol is presented. The ionizing radiation is ionized knock-on atoms (KOA). KOA's are produced by elastic and inelastic collisions with high-energy fission neutrons. A spherical bubble in a superheated liquid will grow spontaneously if its radius is greater than the critical radius, r_c, where $r_c = 2\sigma/P_v - P_l$, σ = surface tension, P_v = vapor pressure, and P_l = liquid pressure. Existing theory predicts the amount of energy required to produce a vapor bubble of critical radius. The denominator of the above expression is a measure of the amount of superheat. As the superheat increases, the critical radius and the required energy decrease. Therefore, for a given superheat, the ionizing radiation has a minimum energy requirement for bubble nucleation to occur. Not only must the particle possess the minimum required energy, but it must lose this energy in a distance on the order of the critical radius. That is, the energy loss per unit length (LET) of the particle must be sufficient. It is usually assumed that the energy must be deposited in a path length of $2\pi r_c$. Measurements of bubble nucleation have been made in water and ethyl alcohol. Superheat conditions are obtained by the rapid depressurization of a liquid at an elevated temperature and pressure. During the sensitive period of a cycle, a photograph is taken to determine the bubble production rate. Superheats are varied by changing the low pressure of an expansion. The superheat threshold for a bubble production rate of 10^4 sec^{-1} in water from 525 to 547°F has been measured, and the superheat threshold for a bubble production rate of 20 sec^{-1} from 270 to 400°F in both gas-saturated and degassed ethyl alcohol has been measured. There is evidence that ethyl alcohol, unlike water, does not contain stabilized gas nuclei. A comparison of the gas-saturated and degassed data indicates a tendency for gas-saturation to decrease the superheat threshold necessary for bubble nucleation. The degassed ethyl alcohol threshold data are also lower in superheat than the predictions, based on an effective deposition length of $2\pi r_c$. In summary, measurements of KOA superheat thresholds for a particular bubble production rate have been performed in water and ethyl alcohol. Both data imply lower superheat thresholds than the theoretical predictions. Also, superheat threshold measurements in ethyl alcohol demonstrate the fact that gas-saturation enhances the possibility of bubble nucleation. (Diss. Abstr. Int., B)

12954 DESIGN, CONSTRUCTION, AND USE OF A DENSELY PACKED DIGITIZED SPARK CHAMBER WITH INTERNAL TARGET FOR πN INTERACTIONS NEAR 1 BeV/c. Ellis, K. J. Nashville; Vanderbilt Univ. (1972). 170p. University Microfilms Order No. 73-14,506.

Thesis (Ph. D.).

A unique spark chamber system has been developed for multiparticle events. The final spark chamber array consists of 45 electrodes spanning a total length of five inches. The chamber uses $\frac{1}{8}$" spark gaps and has the electrodes rotated in three orientations. The diameter of the electrodes uniformly increase from 3" to $4\frac{5}{8}$" in modular sets of three electrodes. The electrode material is a wire cloth mesh using phosphor-bronze wire and nylon fiber woven at a spacing of 120 filaments per inch. A $\frac{1}{4}$" diameter by 2" length polyethylene (CH_2) target was placed internal to the spark chamber. Each electrode used an individual magnetostrictive readout and all data was collected using a small on-line computer (8K memory). Approximately 500,000 πN events were recorded using the system at the Brookhaven Alternating Gradient Synchrotron (AGS). The beam was tuned for pions with an incident momentum of 1080 MeV/c ± 11 MeV/c. An external scintillation counter array was designed to enhance the collection efficiency of sigma-type events. The πN data has been analyzed and compared with known differential cross section data. A series of extensive Monte Carlo programs were developed to test each phase of the analysis procedure. The results from the πN data compare favorably (within 10%) with the Monte Carlo simulations. The design and construction of the spark chamber, along with a complete description of the Monte Carlo programs, is included in the appendices. The system was originally designed for the measurement of the magnetic moment of the sigma plus hyperon. The track resolution of the system, based on the πN data analysis, indicates that no significant improvement over previous measurements of the magnetic moment could be expected. (Diss. Abstr. Int., B)

12955 STATISTICAL METHODS FOR BUBBLE CHAMBER ANALYSIS. Lohrmann, E. (Deutsches Elektronen-Synchrotron, Hamburg). pp 193-207 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Two program systems that accomplish the one- and two-dimensional frequency distributions of experimental quantities are described. Estimation of parameters from experimental distributions is discussed. Methods are given for finding an extremum for the likelihood function. (LTW)

12956 DATA PROCESSING FOR ELECTRONIC TECHNIQUES IN HIGH-FREQUENCY EXPERIMENTS. Lindenbaum, S. J. (Brookhaven National Lab., Upton, NY). pp 209-234 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

A discussion on the use of on-line computer techniques with large arrays of directly digitizable detectors is presented. (auth)

Radiometric Instruments

Refer also to abstract 12616.

12957 (ITJ-27) CALIBRATION OF NEUTRON GAUGES FOR MEASURING OF THE SOIL MOISTURE CONTENT IN THE 4π GEOMETRY. I. Two Group Diffusion Theory, Case of an Empty Hole. Wozniak, J. (Institute of Nuclear Techniques, Krakow (Poland)). 1973. 49p. Dep. NTIS (U. S. Sales Only) $4.50.

A solution of the neutron transport equation based on the two-group diffusion approach is given for an infinite medium with a cylindrical cavity, the geometry being a fair picture of the conditions one meets when performing bore-hole measurements. The solution, i.e., the thermal neutron flux, is given in the form of Fourier–Bessel integral. Both the cases of cased and uncased bore-hole are investigated. An Algol 60 program, TWO-D, for the Odra 1204 computer is presented. The program calculates the calibration curves for neutron moisture gauges, i.e., the gauge count rate versus the medium moisture content for the case when a fast neutron source is situated at the middle of the detector sensitive length. Examples of the calibration curves, the medium being sand, for different measurement parameters (bore-hole radius, detector length, casing thickness) are also given. (auth)

12958 DETERMINATION OF LOCAL DENSITY BY GAMMA SCATTERING USING EXTERNAL MEANS. McAdams, V. D.; Kondic, N. N.; Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 16: 64-65(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12959 PENETRATING RADIATION GAUGE. Cho, B. Y.; Pfeifer, R. J.; Utt, O. L. (to Industrial Nucleonics Corp.). U. S. Patent 3,729,632. 24 Apr 1973. Filed date 21 Dec 1970. 14p.

A penetrating radiation gauge includes a pulsed x-ray source for determining wall thickness of articles moving past the source. The gauge is continuously standardized by respectively placing in the source radiation field first and second different standard samples between first and second different pairs of adjacent articles. A detector-responds to the levels of radiation absorbed by articles while thickness is being measured and by the samples while standardization is being performed to derive an output signal exponentially related to the radiation absorption properties of the articles and samples. A linearizing network responsive to the detector converts the exponential relationship into a straight line function whereby a linear relationship between the magnitude of the detector output signal and the absorption property is derived. While the linearizing network is deriving a signal indicative of the radiation absorption properties of the first sample, the straight line relationship is adjusted so that the gauge response is a point on the line having a predetermined output signal corresponding

with the absorption properties of the first sample. While the linearizing network is deriving a signal indicative of the absorption properties of the second sample, the slope of the line is adjusted so that the gauge derives an output signal having a predetermined magnitude corresponding with the absorption properties of the second sample. (Official Gazette)

12960 GAMMA THICKNESS METER. Brizhinev, M. P.; Voropaev, Yu. A.; Pozdneev, D. B. (Gorky State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 8, 1276(Aug 1972).

Translated from Zavod. Lab.; 38: No. 8, 1006(Aug 1972).

An instrument that measures the thickness of iron specimens by means of γ radiation in the case of inelastic scattering of fast neutrons is described. The accuracy of measurements on steel plates was 3 to 4% for thicknesses up to 50 mm and 4 to 10% for thickness from 50 to 100 mm. (TFD)

12961 FIELD CALIBRATION AND EVALUATION OF A NUCLEAR SEDIMENT GAGE. Welch, N. H.; Allen, P. B. (Agricultural Research Service, Chickasha, OK). Water Resour. Res.; 9: No. 1, 154-158(Feb 1973).

Nuclear sediment gage readings were compared to stream cross-sectional sediment concentrations for several storm events over a 3-year period. Calibration curves, developed by least-squares analysis, are presented for individual and combined storm events. Correlation coefficients for individual or combined storm events ranged from -0.86 to -0.99, and all were significant at the 1% level. Standard errors of estimate ranged from ± 172 to ± 1884 ppm. Sediment concentrations predicted with the calibration curves developed in this study were accurate enough for most applications. Although the particular nuclear gage used in this study (cadmium-109 x-ray source with scintillation detector) is probably unsatisfactory for general use, the principle of monitoring sediment concentrations by nuclear techniques appears sound and feasible. (auth)

12962 SOLID MATERIAL SEPARATORS. Robertson, I. M.; Carlow, C. A. (to National Research Development Corp.). British Patent 1,313,756. 18 Apr 1973. Filed date 16 May 1969. 8p.

Apparatus is described for separating solid objects and in particular root crops, such as potatoes, from stone, earth and the like. Grading means are provided for separating the objects into at least two size ranges, and conveying means for passing each size range in a substantially horizontal direction between a source of ionizing radiation and a radiation detector. The detector responds to differences of transparency to the radiation between the materials, and deflecting means are provided, controlled by the detectors, to cause the objects of each size range to travel along different paths. The deflecting means may comprise an inclined ramp flap controlled by the radiation detector so as to be moved clear when an undesired object is detected, and allow the object to fall clear, but to remain in an operative position when the required object is detected, so as to allow this object to slide or roll gently down to a receptacle. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 13147 and 13334.

12963 (SLA-73-5286) LATCH-UP STUDIES IN SILICON CMOS INTEGRATED CIRCUITS. Gregory, B. L.; Shafer, B. D. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 5p. (CONF-730703-2). Dep. NTIS $3.00.

From conference on nuclear and space radiation effects; Logan, Utah, USA (23 Jul 1973).

Latch-up through the four-layer pnpn structures in junction-isolated, bipolar integrated circuits has been responsible, in large part, for the development of dielectric isolation as an important hardening technology. Since pnpn paths can also be present in Complementary MOS integrated circuits, it is important to explore latch-up in this new technology to determine if dielectric isoletion must again be employed. In the present studies, latch-up is considered to be the creation of a low resistance path on a circuit during a radiation or electrical pulse, which remains low resistance even when the pulse disappears. It is demonstrated how pnpn action can occur in CMOS IC's and examine two particular circuits (RCA CD4007A and CD4041A) to relate geometry and material parameters to the latch-up sensitivity of the circuit. (auth)

12964 (SLA-73-5521) CALCULATION OF TRANSIENT THERMAL IMBALANCE WITHIN CRYSTAL UNITS FOLLOWING EXPOSURE TO PULSE IRRADIATION. Hartman, E. F.; King, J. C. (Sandia Labs., Albuquerque, N. Mex.). 1973. 4p. (CONF-730622-1). Dep. NTIS $3.00.

From 27th annual frequency control symposium; Cherry Hill, New Jersey, USA (12 Jun 1973).

Irradiation of a quartz resonator by photons or electrons produces both transient and permanent shifts in the resonant frequency. In the studies of the transient frequency change due to pulse irradiation it is important to estimate the magnitude of frequency offset due to a) the transient temperature excursion of the crystal unit and b) thermally induced stresses (thermal shock) in the crystal caused by temperature gradients within the crystal and materials thermally coupled to the crystal. With this information it is possible to anticipate the extent, and under what circumstances, the observed transient frequency offset is of thermal origin. A study has been made of temperature rises in quartz resonators using a combined photon-electron Monte Carlo transport code. This code was used to compute the energy deposited in materials by pulsed 10 MeV bremsstrahlung x rays and 30 MeV electrons in geometries which model 5 MHz and 125 MHz 5th overtone quartz resonators. In general for the radiation sources considered, and for resonators operating near their frequency vs temperature turnover point calculations indicate that the more significant factor is thermal shock. Frequency shifts of tenths of parts per million, for a dose of 10^5 rad are estimated for the 5 MHz resonator. (auth)

12965 (SLL-73-5233-A) NUMERICAL TREATMENT OF MULTIPLE DIELECTRIC RELAXATION TIMES IN AN IRRADIATED TRANSMISSION LINE. Marx, K. D. (Sandia Labs., Livermore, Calif.). Apr 1973. Contract AT(29-1)-789. 9p. (CONF-730703-3). Dep. NTIS $3.00.

From conference on nuclear and space radiation effects; Logan, Utah, USA (23 Jul 1973).

The photoconductivity and photo-Compton currents associated with charge displacement can vary through the thickness of the dielectric in irradiated transmission lines. These variations can be caused by either the use of a layered dielectric media or by spatial variations in the secondary electron flux or dose. A numerical method for evaluating transmission line response under these conditions is described. (WHK)

12966 RADIATION-HARDENING APPLICATIONS. pp. 87-98 of Silicon Nitride for Microelectronic Applications. Part 2. Milek, J. T. New York; Plenum Publishing Corp. (1972).

A review is presented of the use of SiN_x in the fabrication of radiation-hardened dielectrics. Devices investigated to date include MNS and MNOS capacitors, MNOS-FETs, bipolar transistors, and operational amplifiers. (123 references). (DLC)

Miscellaneous Instruments

Refer also to abstracts 12800, 12831, 13132, 13391, 13412, 13444, 14420, 15125, and 15144.

12967 (SGAE-2131) CAMAC: INPUT CHANGE OF STATE REGISTER. Marschik, W.; Buschbeck, F.; Attwenger, W. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf. Elektronikinstitut). May 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A CAMAC module for the detection of the change of 12 input signal lines is described. The state of the input signal lines is compared with the old state, stored in the module, any change causes a LAM-signal. (auth)

12968 (SLA-73-5303) ULTRA-HIGH VACUUM SYSTEM FOR ION INDUCED CHARACTERISTIC X-RAY ANALYSIS. Beezhold, W. (Sandia Labs., Albuquerque, N. Mex.). 1973. 24p. (CONF-730632-3). Dep. NTIS $3.25.

From international conference on ion beam surface layer analysis; Yorktown Heights, New York, USA (18 Jun 1973).

A new ultrahigh vacuum system designed and constructed primarily for ion-induced characteristic x-ray studies is described. Details of the following four special features of interest are presented: (1) an ultrahigh vacuum beam-line system, (2) a multipurpose scattering chamber, (3) a windowless Si(Li) x-ray detector scheme, and (4) a target manipulator for ion beam experiments with in situ heating and cooling over the range from approximately 1200°C down to 110°K. (auth)

12969 LEAD SLOWING DOWN TIME SPECTROMETER: A TOOL FOR FAST REACTOR PHYSICS EDUCATION. Foell, W. K. (Univ. of Wisconsin, Madison); Atwell, T. L.; Rushton, J. E. Trans. Amer. Nucl. Soc.; 16: 28-29(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

12970 HIGH-FREQUENCY INSTRUMENT FOR MATERIAL STRAIN MEASUREMENT. Billeter, T. R. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 94(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

12971 EMF DRIFT OF CHROMEL/ALUMEL AND W3%/W25%Re THERMOCOUPLES MEASURED IN PILE TO HIGH NEUTRON EXPOSURES. Sandefur, N. L.; Steibel, J. S.; Grenda, R. J. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 111(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

12972 VALVE ARRANGEMENT FOR THE ACCURATE AND QUICK INTRODUCTION OF GASES INTO THE MASS SPECTROMETER (EXCHANGE OF EXPERIENCE). Vetshtein, V. E. (Inst. of Physical Chemistry, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 8, 1301(Aug 1972).

Translated from Zavod. Lab.; 38: No. 8, 1018–1019(Aug 1972).

Twin gas inlet valves made of Teflon with metal seats for the ion source for mass spectrometers are described. (WHK)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

12973 POSSIBLE APPLICATIONS OF LASER ISOTOPE SEPARATION TO NUCLEAR AND CONVENTIONAL TECHNOLOGIES. Altschuler, S. J. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 16: 9(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

12974 TRITIUM AND HYDROGEN EXTRACTION PLANTS FOR ATOMIC POWER REACTORS. Damiani, M. (Sulzer Brothers Ltd., Winterthur, Switzerland); Getraud, R.; Senn, A. Sulzer Tech. Rev.; 54: No. 4, 283-287(1972).

The design and operation of a rectification plant for extracting hydrogen and tritium from heavy water are described. The plant, manufactured by Sulzer, is situated in the high flux reactor at Grenoble. (TFD)

12975 INDUSTRIAL ASPECTS OF URANIUM ENRICHMENT. Besse, G. (Societe de Construction d'une Usine de Separation Isotopique, Le Plessis-Robinson, France); Leduc, C. Bull. Inform. A.T.E.N. (Ass. Tech. Engrg. Nucl.); No. 97, 6-8(1972). (In French).

From 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

It is envisaged that by 1980 the development of a new high-capacity uranium isotope enrichment plant will have become indispensable. The gaseous diffusion method has been retained, this method having been proved economically and technically successful in the Pierrelatte plant. Experience gained at this plant demonstrates that important improvements in performance are already possible. Three aspects are particularly important; the barrier, the compressor, and the engineering studies. Since 1967 (the date when studies were initiated for the high-capacity plants), the basic characteristics of the project have been confirmed using pilot plants and laboratory tests. In one years time, the project will be at the implementation stage. (FR)

Isotopic Power Sources

Refer also to abstracts 13177, 13208, 14569, and 14650.

12976 (CONF-730811–1) CURIUM-244 HEAT SOURCE FABRICATION. Lamb, E.; Albertson, D. G.; Brown, P. (Oak Ridge National Lab., Tenn.). 1973. Contract W-7405-eng-26. 11p. Dep. NTIS $3.00.

Equipment and procedures for large-scale production of $^{244}Cm_2O_3$ heat sources, based on developmental work at ORNL, are described. (TFD)

12977 (DP–1192-2) SAVANNAH RIVER LABORATORY ISOTOPIC POWER AND HEAT SOURCES. Part II. Curium-244 and Plutonium-238. Quarterly Progress Report, October-December 1968. Hilborn, H. S. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab). Mar 1969. Contract AT(07-2)-1. 23p. Dep. NTIS $3.25.

Declassified Oct 1972.

The first 36 grams of ^{244}Cm from the Savannah River 5-kg production lot was shipped as curium oxide to Oak Ridge National Laboratory. The product met impurity and gamma radiation specifications. Purity was confirmed by a melting temperature of 2230 ± 25°C. Efficient separations of Cm from Am and Cf were demonstrated using pressurized cation exchange chromatography. ^{243}Am is being routinely analyzed in ^{244}Cm by gamma spectrometry using a lithium drifted germanium X-ray detector system. Spark source mass spectrometry was extended to highly alpha active samples and used to determine simultaneously 70 elements from B through Am in ^{244}Cm oxide. Thermal stability studies showed that only minor stabilization of CmO_2 can be obtained by addition of the more stable AmO_2 to form a mixed oxide. Installation of services and equipping of the extension to the Alpha Materials Facility for small-scale studies of ^{244}Cm fuel materials continued. Conditions were defined for pilot production of ^{238}Pu containing < 20 ppb ^{236}Pu from 600 g of Shippingport Am. Production of > 10 kg/yr of ^{238}Pu with low ^{236}Pu content was projected in conjunction with the resonance reactor production of ^{252}Cf using ^{241}Am-^{243}Am from power reactor fuel reprocessing. (auth)

12978 (DP–1332) SAVANNAH RIVER LABORATORY COBALT-60 POWER AND HEAT SOURCES. Quarterly Progress Report, January–March 1973. Angerman, C. L. (comp.). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). May 1973. Contract AT(07-2)-1. 16p. Dep. NTIS $4.00.

At the request of the AEC, SRL will terminate its development program on ^{60}Co power and heat sources at the end of FY-1973. Significant corrosion occurred on Inconel 600, nickel-plated cobalt metal, and galvanic couples between cobalt metal and superalloys during 10,000-h exposure to seawater; negligible corrosion occurred on other materials tested in seawater or on any of the materials exposed to bottom mud. Iridium capsules containing unirradiated ceramic cobalt compounds were intact after 2500 h in argon at 1600°C. Platinum capsules containing unirradiated ceramic cobalt compounds swelled during 125 h in argon at 1200°C. The thermoelectric generator fueled with ^{60}Co continued to operate satisfactorily after 25 months with an electrical output of 37.6W. (auth)

12979 (LA-UR–73-741) ATMOSPHERE-ENTRY BEHAVIOR OF A MODULAR, DISK SHAPED, ISOTOPE HEAT SOURCE. Vorreiter, J. W.; Burns, J. H.; Pitts, W. C.; Stine, H. A. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 52p. (CONF-730811–7). Dep. NTIS $4.75.

The entry and impact behavior of an isotope heat source for space nuclear power that disassembles into a number of modules that would enter the earth's atmosphere separately in the event of a flight abort are described. These modules are disk-shaped units each with its own reentry heat shield and protective impact container. In normal operation the disk modules are stacked together inside the generator but during a reentry abort they separate and fly as individual units of low ballistic coefficient. Flight tests at hypersonic speeds have confirmed that a stack of disks will separate and assume a flat-forward mode of flight. Free fall tests of single disks have demonstrated a nominal 100 ft/s sea level impact velocity for a practical range of ballistic coefficients. Thermal and structural calculations indicate reentry survival under all possible reentry conditions for speeds up to and including earth escape speed. (auth)

12980 (SAN–857-1) EVALUATION OF PRACTICABILITY OF A RADIOISOTOPE THERMAL CONVERTER FOR AN ARTIFICIAL HEART DEVICE. Phase 1, Final Report. Jones, I. R.; Ridgway, M. G.; Snoke, D. R. (TRW Systems, Redondo Beach, Calif.). Apr 1972. Contract AT(04-3)-857. 336p. Dep. NTIS $10.60.

The objective of the program was to determine the practicability of developing a radioisotope thermal converter for an artificial heart device. The thermal converter, including the radioisotope heat source, and all associated power conditioning and control systems are to be fully implantable and capable of functioning for ten years with high reliability. The device must supply the necessary mechanical, hydraulic, or pneumatic power for a blood pump which provides 100% of the left ventricular pumping function. The principal design ground rules included a daily average power level of 2.8 watts delivered to the blood pump and the following design maxima: 60-W heat source, 1.5 liter volume, 3.0-kilogram weight, and peak power level of 4.44 W. The concepts evaluated included various mechanizations of gas reciprocating, vapor reciprocating, vapor rotary, and thermoelectric cycles, as well as various combinations of these devices. A total of eight different thermal converter systems were found capable of meeting all the design ground rules. These eight systems were compared using previously-defined evaluation criteria and scoring procedures. The preferred concept is an all-electric-output hybrid engine which consists of a thermoelectric stage operated thermally in series and electrically in parallel with an organic vapor turbogenerator. The hybrid engine powers a motor/reciprocator unit which in turn mechanically actuates a Kwan-Gett-type blood pump. The weight and volume of the entire thermal converter (exclusive of the blood pump) are 1.83 kg and 1.33 liters. The thermal converter requires a 49-W heat source and has an overall heat-to-mechanical conversion efficiency of a little over nine percent. (auth)

12981 SAFETY FEASIBILITY STUDY OF THE PLUTONIUM AERODYNAMIC DISC (PAD). Conway, T. W. (NUS Corp., Rockville, MD); Dobry, T. J. Jr.; Maltese, J. G. Trans. Amer. Nucl. Soc.; 16: 2-3(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

12982 CONSIDERATIONS IN THE DESIGN OF THE NUCLEAR-POWERED ARTIFICIAL HEART. Mott, W. E.; Cole, D. W.; Holman, W. S. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 52-53(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

12983 BETACEL NUCLEAR BATTERY DEVELOPMENT AND QUALIFICATION. Greensboro, J.; Lewis, M.; Matheson, W. E.;

Smith, T. H.; Warner, E. E. (McDonnell Douglas Astronautics Richland, WA). Trans. Amer. Nucl. Soc.; 16: 55-56(Jun

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12984 IMPROVED TECHNOLOGY FOR MULTIWATT RADIOISOTOPE HEATER UNITS. Barsell, A. W.; Goranson, R. B.; Clements, P. R. (McDonnell Douglas Corp., Richland, WA). Contract AT(45-1)-2166. Nucl. Technol.; 19: No. 2, 117-125 (Aug 1973).

Aerospace radioisotope heater technology has been developed through analysis and testing of improved containment and ablation materials and configurations. To best meet the widest application range, an unvented ^{238}Pu sphere/cube heater in two power sizes, 5 and 50 W(th), is recommended. The critical design constraint is helium pressure containment during reentry for up to 20 y. An ATJ-S graphite ablator combined with a heat-treated pyrolytic-graphite insulator wrapped around a T-111/Pt-20 wt % Rh capsule is the optimum configuration using current technology. A HfB_2 composite currently being developed would provide a major reduction in ablation rates. Computer-optimized geometry and layer thicknesses are described. The design approach was verified by fabrication and key development testing of prototype heater units. (auth)

12985 CHARACTERISTICS OF RADIOISOTOPE POWER SOURCES IN AN OCEAN ENVIRONMENT. Gritton, E. C.; Erdmann, R. C.; Ozeroff, M. J. (Rand Corp., Santa Monica, CA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 32-33(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Radiation Sources

Refer also to abstracts 12805, 12935, and 13048.

12986 NATIONAL BUREAU OF STANDARDS GAMMA-RAY STANDARDS AND TECHNIQUES FOR GAMMA-RAY MEASUREMENTS. Ayers, R. L.; Cavallo, L. M.; Coursey, B. M.; Hutchinson, J. M. R.; Mann, W. B. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 69(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

Design and Fabrication

Refer also to abstract 12771.

12987 HIGH-VACUUM PURE-GAS ALPHA IRRADIATION FACILITY. Thiess, P. E.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 16: 58-59(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12988 NONDESTRUCTIVE MATERIALS TESTING BY MEANS OF THE GAMMA RADIATION OF RADIOISOTOPES. Sauerwein, K. Chem.-Anlagen Verfahren; No. 5, 70-73(1972). (In German).

A brief survey is given on the construction, operation, and applications of commercial ^{60}Co and ^{192}Ir radiation sources. (GE)

12989 ELECTRODEPOSITION OF CARRIER-FREE MANGANESE-54, TECHNETIUM-99, AND ACTINIUM-288 FROM AQUEOUS BATHS. Rane, A. T.; Bhatki, K. S. (Tata Inst. of Fundamental Research, Bombay). Int. J. Appl. Radiat. Isotop.; 24: No. 7, 385-389(Jul 1973).

From 13th seminar on electro-chemistry; Karaikudi, India (1972).

A method is described for electrodepositing carrier-free ^{54}Mn, ^{99}Tc, and ^{228}Ac separately on a nickel cathode. The nuclides ^{99}Tc and ^{228}Ac are deposited to better than 95% from an urea oxalate aqueous bath. The maximum deposition obtained with ^{54}Mn was 30%. The optimum conditions were determined by studying the effects of electrolyte concentration, the current density and the time of deposition. Additional studies include the influence of various other electrolytes such as ammonium oxalate, oxalic acid, pyridine, ammonium carbonate etc. Among these various aqueous baths studied a saturated solution of urea oxalate was found to give the maximum yields in all these cases under investigation. (auth)

12990 DESIGN AND CONSTRUCTION OF A PHOTONEUTRON SOURCE FROM Sb-Be AND ITS APPLICATION IN EDUCATIONAL LABORATORIES. Morales Guerrero, L. E. Monterrey, Mexico; Instituto Technologico y de Estudios Superiores de Monterrey (1973). 128p. (In Spanish).

Thesis.

In order to introduce students in the higher grades to the field of nuclear energy, two photoneutron sources of Sb-BeO were designed with fluxes of the order of 10^5 and 10^6 n/s. These sources consist essentially of a sealed cylindrical container of metallic Sb that is introduced into another receiver containing BeO. The difference between these sources results from a difference in the dimensions of the BeO containers. This coaxial cylindrical arrangement will emit neutrons as a result of the γ,n reaction in Be. The analysis of the neutron flux is carried out by two different γ activities in the Sb. In the calculation of the γ activity thermoluminescent detectors and the Eberline Teletector were used. The method used in the calculation of the neutron flux was that of activation analysis. Included are some experiments in nuclear physics that justify the use of neutron sources in educational laboratories. (tr-auth)

12991 TRITIUM BETA RADIATION SOURCES. Manin, A. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 178, 65-67(Feb 1973). (In French).

Tritium radiation sources usually consist of a thin deposit of tritiated titanium on a metallic substrate. The x and beta radiation emitted have applications in the following fields: beta-electric conversion (collection of electrons emitted, or irradiation of photoelectric cells); utilization of ionization phenomena (detection of smokes, detection in electron capture analysis equipment); utilization of x-ray emission (analysis by x-ray fluorescence). (FR)

Industrial Uses

Refer also to abstracts 12871, 13021, and 13025-13032.

12992 CURRENT STATUS OF INDUSTRIAL RADIATION PROCESSING. Silverman, J. (Univ. of Maryland, College Park). Trans. Amer. Nucl. Soc.; 16: 50(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12993 FOOD IRRADIATION. Urbain, W. M. (Michigan State University, East Lansing). Trans. Amer. Nucl. Soc.; 16: 53-54(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

12994 TRACER CONCENTRATION RESPONSES AND MOMENTS FOR MEASUREMENTS OF LAMINAR FLOW IN CIRCULAR TUBES. Gardner, R. P.; Felder, R. M.; Dunn, T. S. (North Carolina State Univ., Raleigh). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 253-270(May 1973).

Expressions are derived for the response to a tracer pulse injection into a fluid flowing with a parabolic velocity profile in a cylindrical channel. Injections of finite duration and a finite monitored volume are considered, and the injection and detection are each either uniform or proportional to velocity across the channel cross section. Methods are suggested whereby the derived responses and their moments, for which expressions are also given, may be used in conjunction with experimental data to determine the flow rate and channel volume under laminar flow conditions. Of particular interest is the application of radioactive tracers to the measurement of blood flow. Feasibility experiments in a $\frac{3}{4}$-in. pipe indicate that reproducible results that approach the idealized case of uniform injection and detection can be obtained with syringe injections. (auth)

12995 SOME APPLICATIONS OF RADIOISOTOPES AS TRACERS. Grycuk, E. R. Mexico City; Universidad Nacional Autonoma de Mexico (1973). 77p. (In Spanish).

Thesis.

For the simple cases studied it could be observed that the equations obtained by Taylor were similar to the solution of the molecular diffusion equation. This similarity can be considered as due to the fact that the tracer in a tube performs according to an equation analogous to that of the process of molecular diffusion. The basic difference between the proceses, nevertheless, is in the magnitude of the coefficient of diffusion or dispersion, being greater for the case of a turbulent fluid in a tube. In general, in the study of the process of the transport of materials it is very common to encounter this type of equations that can be considered as basic for these studies. The diffusion equation, in general, is of immediate application in movements of water or petroleum in subterranean strata. From the concentration vs time curves that can be obtained by the use of radioisotopes as tracers, in an aquifer or at laboratory level, in a column or porous medium, it is possible to obtain parameters such as: porosity, transmissibility, permeability, and flow across the formation or medium. Starting with the results obtained by means of the use of radioactive tracers, it is possible to make mathematical models that describe the behavior of the system under study. (tr-auth)

12996 LUMINESCENT PAINTS AND SELF-LUMINESCENT LAMPS. Desroches, J. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 178, 69-71(Feb 1973). (In French).

In recent years tritium has replaced radium for the luminescent marking of watch and clock dials. Self-luminescent lamps consisting of pyrex bulbs, whose inner walls are coated with an optimum thickness of a zinc sulfide layer are described. These bulbs are filled with gas at a pressure of less than 1 atmosphere and then sealed. The brightness obtained is less intense than that of an electric light bulb, but is five to ten times greater than that obtained with luminescent paints. (FR)

12997 STUDIES ON THE DIFFUSION AND MIXING OF SOLID PARTICLES IN A TUBE MIXER. 4. Practical Studies on a Binary System With One Radioactivated Component. Radwan, M. H. S. (Cairo Univ.); Abdel-Hamid, A. A.; Hanna, S. B. Int. J. Appl. Radiat. Isotop.; 24: No. 5, 281-289(May 1973).

A programme of experimental work was carried out according to a statistical design with the attempt to study the effects and possible interactions of different factors affecting the mixing operation. Clean sand particles sieved to different fractional sizes were activated by soaking in an acidic solution of ^{60}Co. The count rates of the different part-volumes were taken as a measure of the contents of the activated component. The diffusion rates were determined in all experimental runs, while the degrees and rates of reduction of bad mixing were evaluated in some of them. The data obtained elucidate that diffusion is a major factor in the mixing operation together with convection and shear. Analysis of variance clarifies the overwhelming significance of speed of rotation, volume occupied of the mixer, tube length, differential particle size and some of the factorial interactions. (auth)

12998 MEASUREMENT OF WEAR OF LININGS ON FURNACES USING RADIOISOTOPES. Katona, L.; Pocze, L. Banyasz. Kut. Intez. Kozlem.; 105: No. 9, 407-411(Sep 1972). (In Hungarian).

The measurement, by a ^{60}Co radioisotope, of lining wear in a kiln is described. The various methods of measurement and the absorption of radiation in the walls are discussed in detail. (Metals Abstr.)

12999 HIGH ENERGY RADIATION CURING OF SYNTHETIC RESIN COATINGS. Arbuckle, K. H.; Lazarus, D. M. (to Berger, Jenson and Nicholson Ltd.). British Patent 1,314,329. 18 Apr 1973. Filed date 20 Oct 1969. 6p.

It is stated that the application of high-energy electron irradiation to the curing of paint films has posed severe practical difficulties, and commercial processes that are fully satisfactory in all respects have not been achieved. One such difficulty arises from the fact that the high-energy electrons are produced within a high vacuum chamber and in view of the mechanical difficulties that arise in passing a moving belt through a vacuum chamber it is usual to allow the electrons to pass out of the vacuum chamber through a thin metal window into a region of higher pressure through which the belt may be passed. This leads to low efficiency utilization of the electrons, the proportion of energy absorbed by the window being high. Furthermore, heat generated in the thin window must be dissipated effectively if melting is to be avoided, and this poses practical difficulties. The object of the system described, is to provide for the curing of paint coatings with high energy electrons in a more efficient manner. A beam of high-energy electrons is generated within a high vacuum chamber and emerges, without passage through a solid window, into a region of higher gas pressure wherein the coating is located. The electron beam is diffused by the gas in the higher pressure region, and the coating is irradiated with the diffused beam to cure the synthetic resin composition. Examples are given. (UK)

LIFE SCIENCES

13000 (AGARD-CP-110) CURRENT STATUS IN AEROSPACE MEDICINE. Papers Presented at the Aerospace Medical Panel Specialist Meeting Held in Glasgow, Scotland, 7-8 September 1972. Jones, W. L. (ed.). (Advisory Group for Aerospace Research and Development, Paris (France)). Feb 1973. 76p. (CONF-720992-).

From aerospace medical panel specialist meeting; Glasgow, Scotland (7 Sep 1972).

A separate abstract was prepared for one paper. Ten additional papers discuss the physiological response of astronauts to the space ship environment, various physiological testing methods, and recent developments in aerospace medicine technology. (CH)

For an abstract of an individual paper see: 13016.

Radiation Effects on Biochemicals

Refer also to abstracts 13018, 13101, and 13344.

13001 (ANL-7970, pp 65-66) PHOTOREACTIONS OF 8-METHOXYPSORALEN AND DNA IN VITRO. Ecker, R. E. Dec. 1972.

In Division of Biological and Medical Research annual report, 1972.

Effects of ultraviolet radiation on the formation of covalent photoadducts by the binding of tritiated 8-methoxypsoralen to Escherichia coli DNA were studied. Equations are presented to represent the reactions. It is suggested that the photo-addition of the furocoumarin to DNA is the primary molecular lesion in this type of skin carcinogenesis. (HLW)

13002 (UCB-34-P-190-X-1) PROGRESS REPORT FOR THE PERIOD 1 SEPTEMBER 1972-31 AUGUST 1973. (California Univ., Berkeley. Dept. of Biochemistry). [nd]. Contract AT-(04-3)-34. 5p. Dep. NTIS $3.00.

The role of various DNA enzymes in the repair of uv- or x-irradiated DNA and in DNA recombination is being investigated. The results of these investigations to date are briefly discussed.

13003 ORDER OF INJECTION OF T7 BACTERIOPHAGE DNA. Pao, C. C. Speyer, J. F. (Univ. of Connecticut, Storrs). Journal of Virology; 11: No. 6, 1024-1026(Jun 1973).

The deoxyribonucleic acid (DNA) corresponding to the left-hand end of the genetic map is injected first in T7 phage infection. The order was deduced by use of marker rescue experiments to see which genes are still injected after the double-stranded DNA chain is broken by x rays. The treatment causes a selective loss of genes located on the right side of the map. Presumably, this corresponds to the tail end of normally injected DNA, and x rays cut off this end. (auth)

13004 EQUAL SENSITIVITY OF THE TWO STRANDS OF ϕX174 REPLICATIVE DNA TO BREAKAGE BY IONIZING RADIATION. Achey, P. M.; Courtney, D. G. (Univ. of Florida, Gainesville). Biophys. J.; 13: No. 1, 72-79(1973).

The supertwisted, double-stranded, replicate intermediate of ϕX174 DNA (RFI) was used to determine whether one of the two strands of the double helix is uniquely sensitive to induction of single-strand breaks by ionizing radiation. This could result from a particularly sensitive base sequence or a transfer of energy to a specific location of the DNA molecule. The results indicate that both strands of the double helix are equally broken, even though their base compositions are significantly different. If there are hot spots in the strands, then they are present in equal amounts in each strand. (auth)

13005 BREAKAGE OF PARENTAL DNA STRANDS IN HAEMOPHILUS INFLUENZAE BY 313 nm RADIATION AFTER REPLICATION IN THE PRESENCE OF 5-BROMODEOXYURIDINE. Beattie, K. L. (Oak Ridge National Lab., TN). Biophys. J.; 12: No. 11, 1573-1582(Nov 1972).

Haemophilus influenzae was labeled with thymidine-^{3}H (dThd), then grown in the presence of 5-bromodeoxyuridine (BrdUrd), and then irradiated with 313 nm light (a wavelength that selectively photolyzes DNA containing 5-bromouracil [BrUra]). Irradiation with 313 nm light induced breaks in the ^{3}H-labeled strands in cells grown with BrdUrd at a much higher frequency than in ^{14}C-labeled DNA of cells not exposed to BrdUrd. Breakage of the ^{3}H-labeled strands was about 0.6% as efficient as that of fully BrUra-substituted DNA. During growth in the presence of BrdUrd, susceptibility to 313 nm-induced breakage of the ^{3}H-labeled DNA strands increased, reaching a maximum in about one generation, and it decreased to zero during subsequent growth for one generation in medium containing dThd instead of BrdUrd. Heat denaturation of DNA extracted from dThd-^{3}H-labeled cells grown in the presence of BrdUrd eliminated 313 nm-induced breakage of the ^{3}H-labeled strands. It is concluded that breakage of the ^{3}H-labeled DNA strands resulted from reaction with photoproducts in the base-paired, BrUra-containing strands, rather than from photolysis of BrdUrd incorporated into parental strands. It may be possible to utilize the phenomenon of interstrand breakage in physical studies of DNA replication. (auth)

Radiation Effects on Cells

Refer also to abstracts 12926 and 13101.

13006 (ANL-7970, pp 38-39) DETERMINATION OF THE RBE FOR CHROMOSOMAL ABERRATIONS DURING THE CELL CYCLE OF CULTURED HUMAN LYMPHOCYTES. Carrano, A. V. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

The neutron irradiation for the unstimulated blood has been completed. Preliminary analysis of the dose response indicates that the RBE for chromosome deletions as compared to 250 kVp x rays (x-ray data obtained from a separate analysis) is approximately 4.5. Two-hit aberrations (dicentrics, centric rings, and tricentrics) demonstrated a linear response following neutron exposure with a slope of about 1.0, wherever the slope for chromosome deletions was about 0.9. (auth)

13007 (ANL-7970, pp 83-85) MECHANISM OF ERYTHROCYTE AGING AND DESTRUCTION. II. Effect of X-irradiation on Aging of Erythrocytes. Rahman, Y. E.; Groer, M.; Elson, D. L. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Blood was collected from rats that had been injected with ^{59}Fe and x-irradiated at doses of 500, 5,000, and 20,000 R. The irradiated blood was then injected into rats and the radioactivity of ^{59}Fe in the blood of these rats was determined at intervals over the following 60-day period. Results showed that erythrocytes were radioresistant at doses up to 5,000 R. At a dose of 20,000 R a fraction of the irradiated cells was rapidly removed from the circulation and subsequently released. (HLW)

13008 (ANL-7970, pp 132) STUDIES WITH MAMMALIAN CELLS IN CULTURE. II. Sensitization of Chinese Hamster Cells to X Rays by Succinimide, N-Ethyl Succinimide and Para-Chloromercuriphenyl Sulfonic Acid. Sinclair, W. K. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

N-ethylsuccinimide (NES) showed a marked sensitization effect at 2 mM in phosphate buffered saline with only a slight toxicity of the agent. Studies are now being carried out in synchronous cells to determine whether NES has differential sensitization and pre- and post-irradiation effects similar to those of N-ethylmaleimide. Studies with para-chloromercuriphenyl sulfonic acid established that concentrations in the range of 0.05 mM to 0.10 mM in saline sensitize without being too toxic. (HLW)

13009 (ANL-7970, pp 134-135) STUDIES WITH MAMMALIAN CELLS IN CULTURE. V. Sulfhydryl Content of Synchronous Chinese Hamster Cells. Archer, J.; Long, M. D.; Sinclair, W. K. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Techniques are described for measuring the sulfhydryl content of synchronous Chinese hamster cells. The SH groups in the plasma membrane and nuclear membrane isolated from the cells were studied using a spin-labeling technique. The study is being continued with x-irradiated cells to attempt to demonstrate membrane damage caused by irradiation. The isolation of peptides containing SH from the membrane and nucleoproteins of the cells is also being studied. (HLW)

13010 (ANL-7970, pp 136-137) CHROMOSOMAL ABERRATIONS INDUCED BY JANUS NEUTRONS AND X RAYS IN CHINESE HAMSTER CELLS. Yu, C. K.; Sinclair, W. K. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Chromatid breaks were induced in cells irradiated by neutron doses of 60 to 250 rad and by x-ray doses of 250 to 625 R. The response to neutrons was linear while that for x rays increased more rapidly with dose. The RBE was a function of dose and was about 3.7. (HLW)

13011 (ANL-7970, pp 137) CHROMOSOME LESIONS VISUALIZED BY SCANNING ELECTRON MICROSCOPY. Yu, C. K. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Cultured hamster cells were treated with 1000 R of x rays. The aberrant metaphase chromosomes were arrested by colcemid and examined by light microscopy. The same chromosomes were then isolated for scanning electron microscopy. Chromosome aberrations included breaks, gaps, exchanges, and rings. Chromosome gaps observed by light microscopy appeared to be clean breaks. However, electron microscopy showed that a single chromosome strand connected the two segments. (HLW)

13012 (LA-UR-73-526) TUMOR CELL IDENTIFICATION AND SEPARATION USING HIGH-SPEED MULTIPARAMETER CELL SENSING TECHNIQUES. Mullaney, P. F.; Steinkamp, J. A.; Raju, M. R.; Horan, P. K. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 22p. (CONF-730437-1). Dep. NTIS $3.25.

Instrumentation for rapid identification and separation of mammalian cells based on properties such as volume, fluorescence, and light scattering is described. A multiparameter cell sorter permits a physical isolation of cells based on measurement of one or more physical parameters. Biological applications have included cell identification based on DNA content, life-cycle analysis, immunofluorescence studies, radiation and drug effects, and tumor cell identification and separation. Histograms of DNA frequency were obtained for cultured sarcoma cells subjected to 300 rads of x rays at several times following irradiation. Since Feulgen staining is specific for DNA, it is proportional to cellular DNA content. Changes in DNA content during biological repair and during various phases of the cell cycle were followed for as long as 10 days post-irradiation. (CH)

13013 STUDIES OF THE MECHANISM OF INDUCTION OF INFECTIOUS MURINE LEUKEMIA VIRUS FROM AKR MOUSE EMBRYO CELL LINES BY 5-IODODEOXYURIDINE AND 5-BROMODEOXYURIDINE. Teich, N.; Lowy, D. R.; Hartley, J. W.; Rowe, W. P. (National Institutes of Health, Bethesda, MD). Virology; 51: No. 1, 163-173(Jan 1973).

Previous studies demonstrated the efficacy of two thymidine analogs, 5-iododeoxyuridine (IdUrd) and 5-bromodeoxyuridine (BrdUrd), as inducers of murine leukemia virus (MLV) synthesis in virus-negative cell clones derived from AKR mouse embryos. The results of screening other compounds, such as other base analogs, chemical carcinogens, and mutagens, demonstrate that these two thymidine analogs are by far the most efficient inducers of MLV synthesis in these cells. To obtain maximal activation of virus synthesis by the thymidine analogs, it was necessary to define both the optimal level of drug and time of exposure for each cell system. The studies presented here indicate that incorporation of IdUrd or BrdUrd into cellular DNA plays a vital role in the activation of murine leukemia virus production in the AKR cell lines. If DNA synthesis is blocked or decreased by cytosine arabinoside or serum depletion during the halogenated pyrimidine treatment, the proportion of cells activated is diminished. When analog incorporation into DNA is blocked by simultaneous treatment with thymidine, no induction of virus occurs. When analog incorporation into DNA is enhanced by simultaneous treatment with fluorodeoxyuridine, the proportion of cells induced to produce virus is significantly increased. When cells containing analog-substituted DNA are irradiated with visible light or x rays, the number of cells activated also increases. (auth)

13014 ^{3}H-URIDINE INCORPORATION BY SMALL LYMPHOCYTES. Effect of Antilymphocyte Serum, Cyclophosphamide, and Irradiation. Mhyre, J. G.; Schwarz, M. R. (Univ. of Washington, Seattle). Transplantation; 15: No. 6, 540-545(Jun 1973).

With the possible exception of the lymph node, the small lymphocytes of the lymphoid tissues of normal rats cannot be distinguished on the basis of ^{3}H-uridine incorporation. In contrast, after treatment with antilymphocyte serum, thoracic duct small lymphocytes incorporated less ^{3}H-uridine than lymphocytes from the same compartment of untreated animals. This depression is most likely not attributed entirely to a shift in small lymphocyte populations but may result, in part, from an effect of antilymphocyte serum on individual cells. Surviving cells from cyclophosphamide or total-body irradiated rats did not evidence this shift in the ^{3}H-uridine incorporation. (auth)

13015 REPAIR KINETICS OF RADIATION-INDUCED MITOTIC DELAY. Leeper, D. B. (Univ. of Iowa, Iowa City); Hagemann, R. F. Biophys. J.; 13: No. 2, 179-185(1973).

The recovery from radiation-induced mitotic delay in asynchronous sarcoma-180 (S-180) ascites tumor cells was analyzed in a manner analogous to the repair of sublethal damage. 200-R increments were separated by various fraction intervals (not exceeding the time necessary for mitosis to return to control levels) for total exposures up to 1600 R. The accumulated mitotic delay after the last exposure increment, in percent of an equivalent single exposure, decreased exponentially with overall treatment time in a bimodal fashion. An initial repair process displayed a half time of 2.3 h of overall elapsed time and was followed by a slower process with a half time of 15.1 h. Such a bimodal recovery provides an explanation of why fractionation intervals long with respect to the amitotic period resulting from a single 200 R exposure enhance mitotic delay over that of equivalent single exposures, while shorter fractionation intervals diminish it. It also predicts that mitotic delay vs dose curves should bend toward the abscissa as the exposure time is increased with large single exposures and large fractionated exposures given over short fraction intervals. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 12871, 13004, 13005, and 13108.

13016 (AGARD-CP-110, pp C5.1-6) BIOSTACK EXPERIMENT ON APOLLO 16. Buecker, H.; (and others). (Univ., Frankfurt am Main). Feb 1973.

The objective of the BIOSTACK experiment, flown on board of Apollo 16, was to study the combined action of individual heavy high energy loss nuclei of cosmic radiation and space flight factors on biological systems in resting state. The BIOSTACK experimental package contained a series of monolayers of selected biological objects (Bacillus subtilis spores, Arabidopsis thaliana seeds, Vicia faba radiculae, Artemia salina eggs) with each layer sandwiched between several different physical track detectors (nuclear emulsions, cellulose nitrate, polycarbonate). Individual local evaluation methods have been developed which allow to identify each biological effective particle and to correlate the individual hitting particle with the produced biological effect. A variety of biological effects due to a single penetrating particle analysed include influence on cellular and tissue development, nuclear damages, and mutation induction. The heavy ion flux ($Z \geq 4$) during the Apollo 16 mission has been determined preliminarily as 33 particles/cm^2 of REL $\geq 0.8 \times 10^3$ MeV cm^2/g and 67 particles/cm^2 of REL $<0.8 \times 10^3$ MeV cm^2/g. A cosmic background radiation of 505 to 622 mrad was measured by LiF thermoluminescence dosimetry. (auth)

13017 (ANL-7970, pp 94-97) BIOCHEMICAL EFFECTS OF X IRRADIATION ON YEAST CELLS. Nakamura, K. D.; Dainko, J. L.; Schlenk, F. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

A procedure is described for separation of vacuoles from yeast cells (Candida utilis). Ultraviolet-absorbing compounds were used for testing their integrity. Following x irradiation yeast cells displayed abnormal budding; the bud failed to close off and separate from the parent cell and it grew to an elongated form with a heavy wall. Addition of polyamines such as spermine, spermidine, and putrescine to the post-irradiation growth medium did not correct the defect. (HLW)

13018 (ANL-7970, pp 178-180) DESTRUCTION OF THE PHOTOREACTIVATING ENZYME BY 365 nm RADIATION. Tyrrell, R. M.; Webb, R. B. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

For in vivo studies, cells of Escherichia coli B/r hcr were grown in a medium containing tritiated thymidine. For in vitro studies, DNA was extracted from cells labeled with tritiated thymidine. Dimers induced in DNA by 365-nm radiation in vitro were completely photoreactivable and were removed from the DNA as an exponential function of the illumination time. The activity of the photoreactivating system in E. coli was destroyed in vivo as a function of the dose of 365-nm radiation. The activity of yeast photoreactivating enzyme was destroyed in vitro as a function of the dose of 365-nm radiation at a rate comparable to the destruction of the E. coli enzyme activity in vivo. (HLW)

13019 (ANL-7970, pp 180-182) DESTRUCTION OF DARK REPAIR SYSTEMS BY 365 nm RADIATION. Tyrrell, R. M.; Webb, R. B. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Effects of 365-nm radiation on the survival of Escherichia coli were studied. There was little difference between the survival curve of the wild type competent in excision repair and the survival curve of the excision minus strain. Evidence for destruction of the excision repair system over a biologically significant dose

range was provided by chemical measurements in in vivo systems. More indirect evidence exists for destruction of the rec repair system by comparing inactivation and dimer ratios at 254 and 365 nm. It appeared that the dimers induced by 365-nm radiation were effectively more lethal than for ultraviolet dimers induced in repair competent strains. (HLW)

13020 (ANL-7970, pp 182-184) ULTRAVIOLET LIGHT INDUCED MUTATION IN CHEMOSTAT CULTURES OF ESCHERICHIA COLI WP2 hcr. Kubitschek, H. E. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Very slowly growing chemostat cultures were exposed to uv and the cultures were partitioned into several other chemostats immediately after irradiation and grown in the dark. Latent mutant frequencies decreased at the rate of dilution expected for nonreproducing dimers, that is, decreased by 50% per generation. A slow dark repair process also diminished latent mutant frequencies. Mutation frequencies increased with the final growth rate of the culture. Mutagenesis was a 2-hit process at all cell growth rates. (HLW)

13021 (COO-2038-4) STUDY OF CONTROL OF PUBLIC HEALTH PROBLEMS USING IRRADIATION. Final Report. Maxcy, R. B. (Nebraska Univ., Lincoln. Dept. of Food Science and Technology). 30 Apr 1973. Contract AT(11-1)-2038. 9p. Dep. NTIS $3.00.

Irradiation at a dose level of 200 Krad γ produces little, if any, impairment of flavor of cooked meat products. There is some darkening of the bright red color of uncooked product. These alterations may be of questionable significance, because consumers have traditional concepts of what is safe and good in fresh meat. These concepts may well change with an obvious improvement in the quality of the product. The residual flora after irradiation is of no known unique significance. Presently accepted techniques of quality evaluation and detection of pathogens have the same degree of applicability for irradiated products as for products processed by other methods. (CH)

13022 (COO-3095-11) ULTRAVIOLET LIGHT EFFECTS ON NUCLEIC ACID FORMATION AND GENETIC EVENTS IN BACTERIA. Annual Progress Report. Doudney, C. O. (Albert Einstein Medical Center, Philadelphia, Pa. Dept. of Genetics). Apr 1973. Contract AT(11-1)-3095. 9p. Dep. NTIS $3.00.

This investigation deals with the effect of ultraviolet light on the nucleic acids of the bacterial cell. Exposure to uv prevents DNA replication and also interferes with RNA formation. The program is devoted to studies of cell recovery mechanisms which result in resumption of normal macromolecular synthesis after uv exposure and the mistakes made in the process of these repair mechanisms which lead to mutation or lethality. It includes study of the induction of non-photoreversible damage blocking normal semiconservative DNA replication and presumably leading to a requirement for postirradiation RNA protein formation in restoration of capacity for initiation at the chromosomal origin. It investigates the non-recoverable but photoreversible damage inactivating DNA replication and its relation to cell lethality. It attempts to explore the nature of the mutation induction process and determine its possible relation to the non-conservative DNA replication involved in excision-repair, to recombination processes, and to repair mechanisms dependent on the initiation of semiconservative DNA replication after radiation damage. (auth)

13023 (COO-3271-4) GENETIC TRANSFORMATION IN HEMOPHILUS INFLUENZAE. Three Year Comprehensive Report, September 15, 1970–September 14, 1973. Herriott, R. M. (Johns Hopkins Univ., Baltimore, MD. Dept. of Biochemistry). 1973. Contract AT(11-1)-3271. 41p. Dep. NTIS $4.25.

Progress is reported on the following research projects: purification of the photoreactivating enzyme from yeast; properties of the purified photo-enzyme; photoprotection of ultraviolet irradiated Hemophilus influenzae; the mutagenic action of thymine-hydroperoxide; the specificity of DNA recognition by competent H. influenzae; and pyrimidine nucleoside phosphyorylase from H. influenzae. (HLW)

13024 (STI/PUB-331) FACTORS INFLUENCING THE ECONOMICAL APPLICATION OF FOOD IRRADIATION. PANEL PROCEEDINGS SERIES. Proceedings of a Panel on the Technological Factors Involved in the Economical Application of Food Irradiation, Vienna, Austria, June 14–18, 1971. (International Atomic Energy Agency, Vienna (Austria)). Feb 1973. 141p. (CONF-710664–). IAEA $5.50.

Separate abstracts were prepared for the 10 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 13025–13034.

13025 SOME CONSIDERATIONS WHICH INFLUENCE THE ECONOMIC FEASIBILITY OF FOOD IRRADIATION. MacQueen, K. F. (Atomic Energy of Canada Ltd.). pp 1-12 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664–.

Irradiator design and operation is a well-developed and advanced technology that does not present any real barrier to the application of food irradiation. A real barrier to the commercial development of food irradiation applications is the requirement by most health authorities that each irradiated food must be subjected to extensive toxicity testing before clearance for the use of the process can be given. Many design concepts for food irradiators are possible and two examples are discussed–a simple single-pass concept suitable for the irradiation of vegetables in pallet boxes, and a more complex multi-pass design suitable for the irradiation of fish or other products. Processing costs, based on certain assumptions, were estimated for the irradiation of vegetables, fish, and animal feed. The greatest potential benefit of food preservation by radiation is to help reduce post-harvest food losses, which can amount to 30% or more in some parts of the world. The benefits and limitations of a number of food irradiations are discussed in detail. (auth)

13026 FACTORS INFLUENCING ECONOMIC EVALUATION OF IRRADIATION PROCESSING. Brynjolfsson, A. (Army Natick Labs., MA). pp 13-35 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664–.

An analysis is made of the main factors determining the costs of irradiation processing. The general layout of the production pattern affecting the handling costs is touched upon. The physical characteristics of the radiation, decisive for the choice of radiation source, are illustrated. A cost break-down is made for sources, buildings, conveyor, essential support facilities, and equipment for both ^{60}Co facilities and a 10 MeV electron accelerator facility. These investment cost break-downs are shown as a function of the size of the radiation source. The operational costs are analyzed and shown as a function of source size and hours of annual operation. This analysis of the operational costs, together with amortization rates, tax rates, and interest rates on investment, is then used as a basis for calculating the irradiation costs. The irradiation costs are shown as a function of different parameters, such as source size, dose, throughput rates, and number of hours operated per year. The method of calculation is illustrated by examples giving the calculation of the irradiation costs for disinfestation of grains and radicidation of feed. The curves shown and the examples calculated should give the reader a general picture of the problem and facilitate quick calculations of costs in cases not dealt with specifically in this paper. (auth)

13027 EFFECTS OF TECHNOLOGICAL PARAMETERS ON THE ECONOMIC DESIGN OF FOOD-IRRADIATION UNITS. del Val Cob, M.; de la Cruz Castillo, F. (Junta de Energia Nuclear, Madrid). pp 37-55 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664–.

The various technological parameters that affect the design of food-irradiation units were studied. The variables dependent upon the product, the plant, and the cost, together with the interdependence of these values are considered and the factors governing investment in the radioactive sources and the plant and the total capital cost are discussed. The basic specifications requiring consideration in an irradiation unit project are established. Lastly, the authors study, from the technological and economic points of view, the possibility of irradiating potatoes, garlic, onions, and wheat under Spanish conditions by means of mobile radioactive sources and stationary radiation cells. (auth)

13028 INFLUENCE OF SOME PLANT PARAMETERS ON FOOD IRRADIATION COSTS. Oosterheert, W. F. (Inst. for Atomic Science in Agriculture, Wageningen, Netherlands). pp 57-64 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664–.

A breakdown of costs for food irradiators is given. A series of graphs enables one to evaluate the influence of the various factors on the total price. As an example, the results are applied

on an irradiator for potatoes, which shows that large production capacities, i.e., 60,000 t/yr, are needed. (auth)

13029 INTRODUCING IRRADIATED AGRICULTURAL PRODUCTS ON A LARGE SCALE. A Test Study in a Developing Country. Lapidot, M. (Soreq Nuclear Research Center, Yavne, Israel). pp 65-74 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664-.

The technological, agro-technical, economic, commercial, and psychological factors involved in the introduction of irradiated agricultural products on a large scale are discussed in detail. The information given is based on the experience gained during a test study on the commercial use of an irradiation technique for sprout inhibition in potatoes and onions in Israel. (auth)

13030 COMMERCIAL BACKGROUND OF THE GERMAN SHIPBOARD IRRADIATOR OF SEAWATER FISH AND ITS BENEFITS. Ehlermann, D. (Inst. of Radiation Tech., Karlsruhe, Ger.). pp 75-86 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664-.

The economic situation of the German fisheries' industry is described. The potential benefit of shipboard irradiation of cod, haddock, and red fish is shown on the basis of data from the official statistical tables. The demands of the increasing market for fresh fish can only be satisfied by higher landings. For economic reasons, this goal cannot be achieved by increasing the fishing fleet-it must be achieved by increasing the landings per ship, and this appears only possible by the use of shipboard irradiators. (auth)

13031 ECONOMIC OPERATION OF GAMMA-IRRADIATION PLANTS FOR FOOD PROCESSING: THE LESSONS TO BE LEARNT FROM INDUSTRIAL STERILIZATION. Crawford, C. G. (Storgatan 49, Skaerhamn, Sweden). pp 87-93 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664-.

Based on experience of operating medical-sterilizing plants, suggestions on the design and planning of food-processing plants are made. The importance of choice of package size, flexibility of operation, and careful planning of buildings and peripheral services is emphasized. The relationship between operational efficiency and radiation efficiency is discussed. (auth)

13032 MULTI-PURPOSE IRRADIATION PLANT. Holm, N. W. (Danish Atomic Energy Commission Research Establishment, Roskilde); Christensen, E. A. pp 95-99 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664-.

International and national recommendations for the manufacture of medical supplies emphasize with increasing strength that such products should be physically separated from all other products throughout the entire manufacturing process. This requirement should be taken into account when designing a multi-purpose irradiation plant where it is also intended to irradiate products such as, e.g., food commodities. Some design suggestions are given to deal with this problem. (auth)

13033 FOOD IRRADIATION: BENEFITS AND LIMITATIONS. Urbain, W. M. (Michigan State Univ., East Lansing). pp 101-117 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664-.

Food irradiation is a new process for treating foods. As justification for its development it provides a number of advantages over other food processes. Among these are: better sensory properties of foods, better nutritive value, desirable effects on food safety, broad applicability, delay of senescence of living foods, and improved functional properties. In addition, irradiation provides opportunities for cost reduction and for flexible operation to serve more than one purpose. As with any process, food irradiation has limitations. Among these are: product damage (flavor, color, texture, nutrient loss) in some cases, process requirements such as temperature control, enzyme inactivation, container suitability and large amounts of radiation (in some cases), and problems of efficient facility usage and economic facility size. (auth)

13034 TECHNOLOGY MUST POINT THE WAY. Goresline, H. E. pp 119-133 of Factors Influencing the Economical Application of Food Irradiation. Vienna; International Atomic Energy Agency (1973).

From panel on factors influencing the economical application of food irradiation; Vienna, Austria (14 Jun 1971). See STI/PUB-331; CONF-710664-.

Some of the most promising areas for further developments in food irradiation techniques are outlined with a view to improving the processing methods and with the special aim of making them more economical. The areas considered are: improvement of radiation source design, increase in efficiency of irradiating and handling foods and feeds, proper programming of the exact radiation dose needed, and possibilities of reducing the dose required for a particular application. (auth)

13035 INDUCTION OF INTERFERON BY TEMPERATURE-SENSITIVE MUTANTS OF REOVIRUS, UV-IRRADIATED REOVIRUS, AND SUBVIRAL REOVIRUS PARTICLES. Lai, M. H. T.; Joklik, W. K. (Duke Univ. Medical Center, Durham, NC). Virology; 51: No. 1, 191-204(Jan 1973).

The ability of temperature-sensitive (ts) mutants of reovirus, uv-irradiated reovirus, and subviral particles of reovirus to induce interferon in mouse L929 fibroblasts was investigated. Nine ts mutants belonging to six recombination groups induced about the same amount of interferon as wild-type virus at the permissive temperature (31°C), but only 1 to 17% as much at the nonpermissive temperature (38.5°C). Mutants capable of synthesizing nearly normal amounts of double-stranded RNA, mRNA, and protein and blocked in a late state of morphogenesis, formed little more interferon than mutants completely blocked in the ability to synthesize double-stranded RNA. The amount of interferon induced did not correlate with any viral function except a very late one which resulted in the formation of intact virions. The ability to induce interferon is far more resistant to uv irradiation than infectivity: particles that have received 12 inactivating hits can still induce about 25% of normal interferon yields. The effect of uv irradiation on the interferon inducing ability of ts 447 is striking. This is a RNA$^-$ mutant, which is normally incapable of inducing interferon at 38.5°C; on uv-irradiation, it becomes a potent interferon inducer at 38.5°C. Cells infected with uv-irradiated wild-type reovirus or ts 447 contain at the most 2% as much virus-specific RNA as cells infected with infectious wild-type virus, and may contain very much less. Reovirus top component particles (which lack RNA) and reovirus cores (which lack the outer capsid shell) induce no interferon, even at multiplicities of 100,000 particles/cell. The nature of the mechanism by which uv-irradiated reovirus induces interferon and of the changes caused in ts 447 by uv irradiation that convert it to a potent interferon inducer at 38.5° are discussed in the light of the lack of interferon inducing ability of empty virus particles and cores, and of the absence of virus-specific RNA in infected cells. The mechanism by which uv-irradiated reovirus induces interferon appears to differ from that by which interferon is induced during the productive lytic reovirus infection cycle. (auth)

13036 CELL BIOLOGY OF THE MYCOPLASMAS. Maniloff, J.; Morowitz, H. J. (Univ. of Rochester, NY). Bacteriol. Rev.; 36: No. 3, 263-290(Sep 1973). (UR-3490-54).

The basic points of this review of mycoplasma cell biology were presented as a set of generalizations: difference of morphology among species, with species characteristic cell structure; 0.33 μm (instead of 0.1 μm) as the smallest viable mycoplasmas; cell replication primarily by binary division; and a biochemistry similar to that of other procaryotic cells. The elementary bodies with their promise of novel modes of cell growth and division have proven to be nonexistent. Regarding the last generalization, mycoplasma biology is seen to be qualitatively the same as that of other procaryotes; the only differences are small quantitative ones arising because of the limited cell size and genome. All the complexity of molecular biology is seen in the mycoplasmas, and this must mean that the subtle sophistications seen in the biochemical structures and mechanisms are not evolutionary additions but constitute the fundamental requirements of all biological systems. Ultraviolet and x radiation experiments of mycoplasma cultures showed multihit or multitarget kinetics; i.e., the survival curves showed an initial shoulder followed by exponential inactivation. Ultraviolet repair replication studies showed that the cells were capable of photoreversal of some of the DNA damage. (HLW)

13037 MOLECULAR STRUCTURE OF BACTERIAL PLASMIDS. Clowes, R. C. (Univ. of Texas, Dallas). Bacteriol. Rev.; 36: No. 3, 361-405(Sep 1973).

The molecular structure of bacterial plasmids is reviewed with regard to the following aspects: properties; genetics and linkage of plasmid-borne genes; molecular models for plasmids and their implications for the evolution of R factors; physical composition and form; methods of isolation; methods of molecular weight determination; size and configuration; physical interrelationships; molecular structure of R factors; and aspects of plasmid replication. The use of x radiation for strand breakage in sedimentation analysis and loss of supercoil structure as methods of molecular weight determination is discussed. X radiation was also used in studies on size and configuration of DNA. Transfer replication studies included the use of a conjugation system comprising a non-thymine incorporating donor with an ultraviolet-irradiated, non-DNA-synthesizing recipient. (HLW)

13038 MODEL FOR THE REGULATION OF REPLICATION OF BACTERIAL AND EPISOMAL DNA. Noack, D.; Klaus, S. (Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie, Jena, Ger.). Acta Phys. Acad. Sci. Hung.; 33: No. 3-4, 369-376(1973).

A mathematical model is proposed for the relationship between bacterial cell processes resulting in the initiation of DNA replication that are responsible for DNA and protein synthesis. It is assumed that one or several precursors of DNA synthesis act as a trigger for the replication system of both the bacterial and episomal DNA present. By mathematical analysis it is shown that this model yields a stable cell cycle with a regulated cell volume at the time of intiation of DNA replication. Some proposals resulting from the model are experimentally proved with E. coli strains lysogenic for the λ bacteriophage, the DNA of which is an example of episomal DNA. The initiation timing of phage DNA replication is in accordance with the model, in that the mode and duration of inhibition of bacterial DNA replication causes the accumulation of DNA precursors leading to the initiation of replication of bacterial and episomal DNA. (auth)

13039 ULTRAVIOLET INACTIVATION OF EUGLENA CHLOROPLASTS. I. Effect of Light Intensity of Culture. Cook, J. R. (Univ. of Maine, Orono). Biophys. J.; 12: No. 11, 1467-1473(Nov 1972).

Target numbers for ultraviolet (uv) inactivation of chloroplast replication in Euglena gracilis were about 45 when cells were grown in the dark and about 150 when grown in the light (700 or 1200 foot-candles [ft-cd]). Total cell DNA was about 25% greater in the light-grown cells. (auth)

13040 EFFECT OF TEMPERATURE ON THE REPAIR MECHANISM OF RADIATION-INDUCED DAMAGE IN ESCHERICHIA COLI. Iyer, P. S. (Directorate of Radiation Protection, Trombay, India). Indian J. Biochem. Biophys.; 9: 123-125(Mar 1972).

Some strains of Escherichia coli B have enhanced survival if initially incubated at 18°C after irradiation with x rays or gamma rays. This process is referred to as low-temperature reactivation (LTR). B/r and B_{s-1} cells were studied for the manifestation of LTR under a variety of pre- and post-irradiation incubation conditions. The radioinduced DNA degradation at 18 and 37°C for cells grown in the presence and absence of glucose was also examined. On the basis of the results of radiation survival and DNA degradation, the possible repair mechanism in E. coli B/r is discussed. (auth)

Radiation Effects on Plants

Refer also to abstracts 13016, 15097, and 15151.

Radiation Effects on Animals

Refer also to abstract 15158.

Man

Refer also to abstracts 13001 and 15038.

13041 (SLA-73-5371) EVALUATION OF PERSONNEL EXPOSURES IN A HIGH-ENERGY, HIGH-INTENSITY BETA-GAMMA FIELD. O'Neal, B. L. (Sandia Labs., Albuquerque, N. Mex.). 1972. 7p. (CONF-730603-4; CONF-730907-1). Dep. NTIS $3.00.

From 18th Health Physics Society meeting; Miami Beach, Florida, USA (17 Jun 1973).

A high-energy, high-intensity beta-gamma radiation field occurred in experimental areas of a tunnel complex at the Nevada Test Site (NTS). The beta-to-gamma dose rate ratio in free air was as high as 28 to 1 (83 rad/hr vs 3 R/hr) and the beta-particle maximum energy was 3.5 MeV. Evaluation and recovery of experiments resulted in personnel radiation doses approaching the AEC guidelines. The methods described here were used in evaluating the radiation field and determining an estimate of the relative dose to the skin, gonads, and lens of the eye as measured by both thermoluminescent dosimeters (TLD) and film badges. In addition, problems not normally associated with mixed-field, beta-gamma dosimetry are discussed. (auth)

13042 RADIATION PROTECTION. Recommendations of the International Commission on Radiological Protection. Data for Protection against Ionizing Radiation from External Sources: Supplement to ICRP Publication 15. ICRP Publication 21. Oxford; Pergamon Press (1973). 112p. (ICRP-21). $7.75.

It is stated that the appendices contain information for implementing the recommendations of ICRP Publication 15 and therefore relate to the sources of external radiation encountered in medical, dental, and veterinary radiology, and in industry and research. A substantial portion of the Supplement is allocated to data on shielding, but some shielding problems, such as those associated with nuclear reactors and ultra high energy accelerators, are outside its scope. Reference is made to the citation service provided by the Radiation Shielding Information Center at Oak Ridge National Laboratory, and to the European Shielding Information Service at Ispra. Statements by the ICRP on exposure from intra-oral x-ray tubes and population dose from consumer products are reproduced. The appendices cover the following matters: collision stopping power of charged particles in water; interpolated values of quality factor; quality factor as a function of charged particle energy; calculation of absorbed dose and dose equivalent distribution in the body; conversion factors for electrons; and for photons, conversion factors and effective quality factors for neutrons; and for protons; neutron sources and shielding; range-energy curves; shielding for beta sources; x-ray and gamma shielding. Also included are a list of references and general shielding bibliography. (UK)

13043 OSTEOGENIC SARCOMA FOLLOWING IRRADIATION. Kolar, J.; Bek, V.; Kolihova, E. Cesk. Radiol.; 27: No. 1, 69-72 (Jan 1973). (In Czech).

Two observations of osteogenic sarcomata after irradiation in children are reported. The first case was 14 years after irradiation of retinoblastoma and the second 12 years after irradiation of Wilms tumour of kidney. The number of these complications after external irradiation in the literature has not reached one hundred yet. The prognosis is uncertain. (auth)

13044 EOSINOPHILIA FOLLOWING RADIATION THERAPY. Muggia, F. M.; Ghossein, N. A.; Wohl, H. (Albert Einstein Coll. of Medicine, Bronx, NY). Oncology; 27: No. 2, 118-127(1973).

Serial white cell and differential counts in 114 patients receiving 131 courses of cobalt-60 radiotherapy revealed the following findings: Large field cobalt-60 radiation was associated with eosinophilia in 30% of all such courses. Eosinophilia was most frequent in patients receiving pelvic radiation unrelated to the type of disease treated. Typically the eosinophilia increased progressively to peak values in the 4th week of pelvic radiation. The possibility of antigen-antibody reactions explaining radiation-related eosinophilia (RRE) was investigated by serial observations of serum immunoglobulins. (auth)

13045 CELL POPULATION KINETICS IN RADIATION THERAPY: OPTIMIZATION OF TUMOR DOSAGE. Cohen, L. (Michael Reese Hospital and Medical Center, Chicago). Cancer; 32: No. 1, 236-244(Jul 1973).

A cell population kinetic model and computer program was designed to simulate the effects of fractionated radiation therapy. The probability of tumor control or of an adverse tissue reaction was shown to be directly related to the computed cellular surviving fractions. Collected clinical data were used to estimate median values and standard deviations of the log-surviving fractions corresponding to the tolerance of normal tissues and the response of specific tumors. A cellular-surviving fraction subsequently computed for any given treatment scheme could then be compared with the corresponding median and assigned an associated probit value. These probits permit the radiotherapist to estimate the probability of cure or reaction in specific cases and to compute optimal fractionation schemes, that is those giving lowest probit levels in normal tissue and highest in tumor. An optimization program was used to generate tables of modal doses and probit differences (tumor minus normal), from which optimal values for total dosage, number of fractions, and overall time are derived and presented in the form of a clinical prescription. (auth)

13046 STUDIES OF MORTALITY AND HEALTH STATUS IN WOMEN CURED OF CANCER OF THE CERVIX UTERI. Comparison of Long-Term Results of Radiotherapy and Combined Surgery and Radiotherapy. Kielbinska, S.; Tarlowska, L.; Fraczek, O. (Inst. of Oncology, Warsaw). Cancer; 32: No. 1, 245-252 (Jul 1973).

Long-term follow-up was undertaken of two groups of women evaluated as cured of Stage I cancer of the cervix uteri. One group included 792 subjects treated by radiation alone; the other group included 789 women treated by irradiation after hysterectomy. No differences could be detected between these groups in general health status, mortality rate, cause of death, or the incidence of late recurrence of cancer. The only significant difference was in the type of long-term complications. At the end of the period covered here, all patients had been followed for at least 7 years from the beginning of treatment. Follow-up for a minimum of 10 years was achieved in 573 cases where radiotherapy alone was given and in 565 cases of combined therapy. Three hundred and one women from Group I and 206 from Group II were followed for a minimum of 15 years; 43 women from Group I and 34 from Group II were followed for a minimum of 20 years. The mortality rate in both groups during the 15 years following the first 5-year survival period did not differ significantly from the mortality rate of the general population in the same age ranges. The most frequent cause of death was late recurrence of cancer, accounting for one third of the deaths in both groups. During the 15-year observation period, the incidence of cancer recurrence decreased slowly with the duration of observation. (auth)

13047 NEW METHODS TO FACILITATE RADIOTHERAPY PLANNING AND TREATMENT, INCLUDING A METHOD FOR FAST PRODUCTION OF SOLID LEAD BLOCKS WITH DIVERGING WALLS FOR ^{60}Co BEAM. Kuisk, H. (Veterans Administration Hospital, Minneapolis). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 117: No. 1, 161-167(Jan 1973).

The following aids to radiotherapy are described: a rapid method to produce solid lead shielding blocks with divergent walls to follow the supervoltage beam, which can be ordered from the workshop by a telephonic blueprint code; a technique of supervoltage combined portal filming to avoid burn-out effect of the barium or iodine opacified organs; a quick way to make patterns for irregular lead cut-outs in superficial therapy; and a new moldable tissue density bolus material. (ERB)

13048 EXPERIENCE WITH CALIFORNIUM-252 IN CLINICAL RADIOTHERAPY. Castro, J. R.; Oliver, G. D.; Withers, H. R.; Almond, P. R. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 117: No. 1, 182-194(Jan 1973).

The following conclusions are made on the basis of experimental studies. Afterloading techniques are required to maintain a low exposure dose to personnel and assure a reasonably geometric implant with ^{252}Cf. The clinical impression of 6.5 to 7.0 for the neutron RBE for ^{252}Cf appears correct. A number of patients with advanced disease have had local control of the tumor indicating that ^{252}Cf is an effective interstitial source. Intracavitary use of ^{252}Cf is feasible and may be the easiest to standardize. A ratio of 0.45 micrograms of ^{252}Cf to 1.0 mg of ^{226}Ra is suggested for gynecologic implants. Increased precautions and care must be taken in handling ^{252}Cf and patients to prevent overexposure of health personnel; this must be weighed in assessing the usefulness of ^{252}Cf. Decay of ^{252}Cf may be a problem in maintaining a sufficient amount of the required intensities, especially for gynecologic implants. A bank may be needed to replenish sources fairly frequently. A controlled clinical trial will be needed to prove or disprove the greater effectiveness of ^{252}Cf over that of γ-emitting sources such as ^{226}Ra or ^{192}Ir. (ERB)

13049 HAZARDS OF RADIOTHERAPY OF THE HEAD AND NECK. Ennuyer, A.; Bataini, P. Rev. Prat.; 22: No. 28, 3803-3815(1 Nov 1972). (In French).

After having recalled some of the present possibilities of high energy radiotherapy, the possible complications on skin, mucous membranes, muscle, teeth, bone (in particular at the level of the mandible), larynx, nerves, and eye, as well as the risks of radiocancer and irradiation of growing organisms are discussed. Stress is laid on the means of prevention and treatment of these complications. The authors point out that most of these problems were studied at length in the report of the XXIst French Congress of stomatology: Maxillo-facial and bucco-dental complications of treatment by ionizing radiations, by A. Ennuyer, P. Berthoin, J. Billet, and Cl. Rouchon; Masson Publishers, which contains a considerable bibliography. (auth)

13050 HAZARDS OF PELVIC RADIOTHERAPY. Chassagne, D.; Eschwege, F. (Institut Gustave-Roussy, Villejuif, France). Rev. Prat.; 22: No. 28, 3829-3837(1 Nov 1972). (In French).

The risks of pelvic radiotherapy can be schematically observed on the one hand at the time of irradiation; these are digestive and urinary risks that though troublesome do not usually leave any sequellae. On the other hand and much more important are the remote risks: they are usually digestive and urinary, less often osseous and cutaneous. The frequency of serious complications does not exceed 2%. With the improvement of irradiating technical conditions it should be possible to lower this percentage still further. (auth)

13051 CHROMOSOMAL ABERRATIONS IN MAN DUE TO LOW LEVELS OF IONIZING RADIATION: A PILOT STUDY. Depenbusch, F. L. (Naval Hospital, Long Beach, CA). Mil. Med.; 137: 436-440(Dec 1972).

A review of the effects of high levels and low levels of ionizing radiation upon the body is presented. The effects of low levels of radiation in relation to chromosomal aberrations are discussed in detail. The results of a comparison study of chromosomal aberrations between a group of subjects exposed to ionizing radiation and a control group are presented. A slightly higher percentage of chromosomal aberrations was noted among the exposed group. This is not felt to be of significance, because of the small number of cells examined and because of the small number of subjects in the study. The study does, however, represent an approach to determining the threshold effect in humans. A method is described of transporting serum in a culture medium over great distances to a laboratory, which involves the inoculation of the culture medium with supernatant plasma prior to shipping. (auth)

13052 POSTRADIATION SARCOMA OF BONE. Sim, F. H.; Cupps, R. E.; Dahlin, D. C.; Ivins, J. C. (Mayo Clinic and Mayo Foundation, Rochester, MN). J. Bone Joint Surg.; 54: No. 7, 1479-1489(Oct 1972).

The deleterious effects of radiation on bone are well recognized, and include osteitis, necrosis, stunting of growth, and pathological fractures. In addition, radiation has been implicated in the genesis of sarcomas arising in previously irradiated bone. A definite relationship between exposure to radiant energy and development of sarcomas has been established in experimental animals. Approximately 150 cases of sarcoma arising in bone following irradiation have been recorded, often in isolated case reports but also in several major series. Previously, twenty-one cases from the Mayo Clinic were reported. The purpose of this present study is to document an additional thirty-four cases of postradiation sarcoma of bone seen at the Mayo Clinic and to review the literature. (auth)

13053 RADIATION-INDUCED CARCINOMA OF THE TRANSVERSE COLON; REPORT OF A CASE. Cunningham, M. P.; Wilhoite, R. (St. Francis Hospital, Evanston, IL). Dis. Colon Rectum; 16: No. 1, 145-148(1973).

A rare combination of circumstances created a setting for high-dose radiation therapy to the transverse colon, leading to the development of carcinoma. This uncommon event must be considered a clinical curiosity and does not reflect unfavorably upon the need for or efficacy of postoperative radiation therapy in properly selected cases. (auth)

13054 CONTRIBUTION OF NATURAL TERRESTRIAL SOURCES TO THE TOTAL RADIATION DOSE TO MAN. Auxier, J. A. Atlanta; Georgia Inst. of Tech. (1973). 191p. University Microfilms Order No. 73-14,087.

Thesis (Ph.D.).

The central objective of this research was the analysis and synthesis of data available concerning human exposures to the natural terrestrial radiation environment and the solution of some key problems that appeared to be hampering the understanding of it. A better knowledge of the natural radiation environment appears to be necessary to a realistic interpretation of the effects of low levels (for example, current occupational guide levels) of radiation exposure of man. Specific objectives included a determination of the important parameters affecting radon emanation from concrete, the measurement and correlation of the γ spectra from radionuclides for typical concentrations in soil, a determination of the possibility and practicability of using high resolution spectrometers to measure low levels of radioactive contamination due to human activities, and an evaluation of major sources of external and internal human exposure due to the natural radiation environment. It was demonstrated that the most important parameter in controlling the emanation of radon from concrete is the free moisture content of the concrete. Within the normal range of home temperatures, the temperature of the concrete is not a sensitive parameter and thus has negligible effect on the emanation. Radon concentrations in dwellings constructed of uranium bearing materials are often in the range 1 to 5 picocuries/liter of air. These concentrations result in the irradiation of the basal cells of the bronchial epithelium near the first five bifurcations by the α emitting daughters of radon that often exceeds, sometimes by a large factor, the average whole-body absorbed dose due to the γ rays from the natural radiation environment. Further, the doses to these basal cells over a 50-year span may approach the levels at which the incidence of lung cancer in uranium miners is increased by a factor of two over the normal incidence in men of the same age. (Diss. Abstr. Int., B)

Vertebrates

Refer also to abstract 13101.

13055 (ANL-7970, pp 8-9) JANUS PROGRAM DATA MANAGEMENT. Williamson, F. S.; Holmblad, G. L.; Nash, B. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Data management emphasis was shifted to the entry of death data and to the preparation of listings and displays showing the current status of the 10,000 mouse subjects. (MCG)

13056 (ANL-7970, pp 13-29) PROGRESS OF JM-2 AND RELATED NEUTRON- AND GAMMA-RADIATION TOXICITY STUDIES. Ainsworth, E. J.; Fry, R. J. M.; Grahn, D.; Williamson, F. S.; Rust, J. H.; Brennan, P. C.; Carrano, A. V.; Jordan, D. L.; Miller, M.; Allen, K. H.; Nielsen, M. P.; Cooke, E.; Staffeldt, E.; Sallese, A. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Basic mechanisms of neutron and gamma radiation injury and recovery in various tissues and organs of mice were studied. Following exposure of mice to fractionated doses, data were obtained on incidence of lung tumors; infection with Mycoplasma pulmonis, Enterobacter cloacae, Proteus sp., and viruses; pathology; and mortality. A sacrifice series was conducted to provide information on cell and tissue injury at various times after fractionated or single exposures; graphs are presented to show hematopoietic responses. Acute lethality studies were conducted to determine the extent to which $LD_{50/30}$ or $LD_{50/6}$, respectively, could be related to survival of hematopoietic or intestinal stem cells. Hematopoietic injury and recovery were evaluated after whole-body exposure of mice to 288 neutron rad or 740 rad of gamma radiation. Effects of age on femur stem cell content in mice were studied; no evidence for an age-related decrease in stem cell content was observed. Late radiation effects on susceptibility to the transmissible leukemia cells were evaluated at 250 and 300 days after an acute exposure to 740 rad of gamma radiation or 288 rad of neutrons. (HLW)

13057 (ANL-7970, pp 29-36) INTERIM ANALYSIS OF DEATH RATE STATISTICS; EXPERIMENT JM-2. Grahn, D.; Ainsworth, E. J.; Fry, R. J. M.; Williamson, F. S.; Rust, J. H. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Tables and graphs are presented to show death rates and mortality probabilities of mice exposed to neutron and gamma radiation. A high degree of dose-additivity was noted for neutron exposures. Life shortening predictions are premature as there are still some non-linear changes in the rate of increase in mortality that must stabilize before more complex functions can be fitted to the data for prediction purposes. The data suggest that analysis can be made on the basis of present models of radiation injury. In the case of gamma radiation,the results show that a 24-week fractionation period is sufficient to bring the animals into the injury mode typical of low-intensity low-dose exposure. (HLW)

13058 (ANL-7970, pp 36-38) EFFECT OF RADIATION ON SUSCEPTIBILITY TO RESPIRATORY INFECTION. Brennan, P. C.; Kickels, W. T.; Simkins, R. C. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Gamma and neutron radiation were administered to mice and they were challenged with Mycoplasma pulmonis in a concentration estimated to produce pneumonia in 10 to 15% of normal unirradiated mice. Mice that received three 15 min exposures per week at 0.9 rad/min showed a significantly increased susceptibility to infection compared with animals given one exposure per week or one exposure per 4 weeks. Comparisons between fission neutron and gamma-irradiated animals indicated that the RBE under conditions of dose fractionation was greater than 2.6. (HLW)

13059 (ANL-7970, pp 40-42) MEASURE OF CAPILLARY BLOOD FLOW IN IRRADIATED MOUSE TISSUES. Stearner, S. P.; Christian, E. J. B. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Effects of radiation on microvascular changes in mice were studied using ^{133}Xe. The technique is described and results are tabulated for rate of capillary blood flow in the lung, liver, kidney, and subcutaneous region of the dermis. Vasodilatation and venular tortuosities that occurred within 4 days after a radiation exposure in the acute lethal range appeared to be associated with a slower clearance, while washout rates tended to be faster when the vasculature was constricted. (HLW)

13060 (ANL-7970, pp 42-44) MICROVASCULAR EFFECTS OF NEUTRON AND GAMMA RADIATIONS IN THE MOUSE. Stearner, S. P.; Christian, E. J. B. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Mice were exposed to fast neutrons from the JANUS reactor or to ^{60}Co gamma rays. Maps of the major blood vessels of the pinna were constructed from enlargements of photomicrographs. After an exposure in the acute lethal range, a vasodilatation was present in both arterioles and venules within 1 or 2 days. Stasis in a few vessels and tortuosities in some smaller veins were also seen. Vasodilation decreased after a week in most individuals that survived beyond 30 days. (HLW)

13061 (ANL-7970, pp 45-46) RESPONSE OF MICE HETEROZYGOUS FOR GENES INDUCING MACROCYTIC ANEMIA TO SINGLE AND DAILY EXPOSURE TO IONIZING RADIATION. Grahn, D.; Allen, K. H. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Data were accumulated on the response of two mutants to single and daily exposures to x and gamma radiation. Differences between the two mutants were observed in the responsiveness of their marrow stem cells to proliferation-inducing stimuli and in the spleen colony-forming capacity of irradiated stem cells. The response to radiation stress in survival terms revealed the independence of genetic action of the two mutants. The data support the thesis that there is a time/dose-dependent erythropoietic syndrome. (HLW)

13062 (ANL-7970, pp 61-63) CELL KINETICS OF MOUSE PULMONARY TUMOR. Fry, R. J. M.; Zeller, C.; Sallese, A. R. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Pulmonary tumors were removed from irradiated mice and small fragments were implanted in syngeneic hosts. The cell cycle was determined after the third tumor transplant. Twenty-eight tumor-bearing mice were injected with $^{3}HTdR$ and killed at intervals from 1 to 27 hr. Results are tabulated and the cell cycle time was estimated to be about 43 hr. (HLW)

13063 (ANL-7970, pp 68-70) STUDIES ON A TRANSMISSIBLE MURINE LEUKEMIA. Ainsworth, E. J.; Devine, R. L.; Fry, R. J. M.; Nance, S. L.; Nielsen, M. P.; Tahmisian, T. N.; Thomson, J. F.; Tallaksen, S. L. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Leukemic cells or plasma were injected into four groups of mice one of which was exposed to 200 R of 250 kVp x rays. At intervals of 1 to 60 days the mice were killed and samples of lymph nodes, spleen, and thymus were prepared for electron and light microscopy. In some experiments spleen cells labeled with $^{3}HTdR$ were injected into irradiated hosts. Suspensions of leukemic cells were injected into mice that had received 200 R of gamma radiation. Histological examinations revealed lymphocytosis and virus particles were seen in the lymph nodes of irradiated and unirradiated hosts. (HLW)

13064 (ANL-7970, pp 75-77) COMPARATIVE BIOLOGY OF AGING IN MYOMORPH RODENTS. III. Life Shortening by Chronic Gamma-Ray Exposure in Myomorph Rodents. Sacher, G. A.; Flynn, R. J.; Tyler, S. A.; Staffeldt, E. F. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Twelve species of rodents were exposed to chronic gamma radiation and data were examined in terms of the relationship between the radiation-specific death rate and the daily dose rate. Results showed that small differences in acute sensitivity become greatly magnified under conditions of chronic exposure and that the female is more radiosensitive than the male. A mathematical model was developed to account for the phenomena observed. (HLW)

13065 (ANL-7970, pp 186-189) MAMMALIAN GENETICS. Grahn, D.; Hulesch, J. L.; Allen, K. H.; Colaianne, J. J.; Lea, R. A. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Progress is reported on the following studies: determination of the x-radioinduced mutation rate for sex-linked lethals and detrimentals in the mouse; evaluation of x-chromosome linkage relationships; and genetic and biochemical analysis of the mutants of the mottled allelic series. (HLW)

13066 (ANL-7970, pp 192-194) RESPONSE OF BEAGLE DOGS TO PROTRACTED EXPOSURE TO ^{60}Co GAMMA RAYS AT 5 TO 35 R/DAY. I. Survival and Clinical Observations. Norris, W. P.; Fritz, T. E.; Poole, C. M. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Studies were conducted on survival times, clinical signs of radioinduced injury, and causes of death in beagles exposed to 5 to 35 R/day of ^{60}Co gamma rays. At 35 R/day the cause of death was always septicemia, usually from microorganisms in the upper respiratory tract. At 17 R/day septicemia occurred in some dogs while others died of anemia or myeloproliferative disease. At 5 or 10 R/day septicemias did not occur and causes of death were anemia or myeloproliferative disease. Survival data are presented in the form of tables and graphs. (HLW)

13067 (ANL-7970, pp 195-196) RESPONSE OF THE BEAGLE DOG TO PROTRACTED EXPOSURE TO ^{60}Co GAMMA RAYS AT 5 TO 35 R/DAY. II. Effects of Terminated Exposures. Fritz, T. E.; Norris, W. P. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Dogs received 4000, 2000, or 1400 R of gamma rays delivered at either 10 or 17 R/day. Other groups received 1400 R at either 10 or 17 R/day. The causes of death, septicemia, anemia, and myeloproliferative disorders, were not different from those in dogs irradiated continuously until death. The minimum total exposure that produced myeloproliferative disorders was 1700 R delivered at 17 R/day. (HLW)

13068 (ANL-7970, pp 197-198) RESPONSE OF BEAGLE DOGS TO PROTRACTED EXPOSURE TO ^{60}Co GAMMA RAYS AT 5 TO 35 R/DAY. III. Effect of Continuous Irradiation During Pregnancy. Norris, W. P.; Poole, C. M. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Pregnant beagles were exposed to gamma radiation at 5, 10, or 17 R/22 hr exposure day for the full term of pregnancy. Of four dogs exposed continuously to 5 R/day, all delivered normal litters. Of nine dogs exposed to 10 R/day, four delivered normal litters; of eight dogs exposed to 17 R/day, only two delivered litters. It was concluded that a continuous exposure rate throughout pregnancy of 17 R/day permitted normal fetal development. No abnormalities were observed in pups exposed to as much as 1000 R during pregnancy. (HLW)

13069 (ANL-7970, pp 199-200) RESPONSE OF THE BEAGLE DOG TO PROTRACTED EXPOSURE TO ^{60}Co GAMMA RAYS AT 5 TO 35 R/DAY. IV. Effects on Spermatogenesis. Tolle, D. V.; Ladove, R. F.; Norris, W. P. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Four young adult male beagles, 12 to 15 months old, were exposed to 5 R/day, while a fifth served as a control. It was found that approximately 60 days of irradiation at 5 R/day were required before an exponential decrease in sperm cell concentration occurred. (HLW)

13070 (ANL-7970, pp 201-202) MICROSCOPIC STUDIES OF LEUKEMIC BONE MARROW. Tolle, D. V.; Tahmisian, T. N.; Devine, R. L. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Bone marrow was removed from two dogs irradiated at 17 R/day for 1015 and 1061 days respectively. Electron microscope observations of the bone marrow cells revealed asynchrony of nuclear-cytoplasmic maturation, a mixed population of cytoplasmic granule types within the same cell, asynchrony of granule maturation and differentiation, coalescence of cytoplasmic granules, and increased proliferation of plasma cells. (HLW)

13071 (ANL-7970, pp 203-205) ROLE OF ADRENAL GLUCOCORTICOIDS IN RESPONSES OF THE BEAGLE TO CONTINUOUS WHOLE-BODY ^{60}Co GAMMA-IRRADIATION. Stone, J. P. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Young adult male beagles were bilaterally adrenalectomized or sham-adrenalectomized and allowed to recover for 2 to 3 weeks; then they were gamma-irradiated at 35 R/day until death. Plasma electrolytes were maintained at normal levels by deoxycorticosterone and sodium chloride. Antibiotic treatments prevented bacterial complications. Thrombocytopenia and leukopenia occurred in all animals. The rate of erythrocyte loss in adrenalectomized dogs was considerably greater than that in sham-adrenalectomized dogs. It seemed evident that glucocorticoids play a role in erythropoiesis. (HLW)

13072 (COO-3267-4) NINETEEN PARACENTRIC CHROMOSOMAL INVERSIONS IN MICE. Roderick, T. H.; Hawes, N. L. (Jackson Lab., Bar Harbor, Maine). 1973. Contract AT(11-1)-3267. 21p. Dep. NTIS $3.25.

Using mutagens on sperm and spermatids 19 chromosomal inversions were produced in mice. The levels of radiation and chemical mutagen induced inversions in about 1 per cent of the animals screened. Nine inversions were transmitted through successive generations, and the particular frequency of first meiotic anaphase bridges manifested by each inversion remained constant. The cytological properties of first meiotic anaphase varied considerably among the inversions. Chromosomal locations of five inversions are known. Four of the five are fully viable in homozygous condition. (auth)

13073 (ORO-3972-14) DEVELOPMENTAL APPROACH TO THE STUDY OF IMMUNOLOGIC TOLERANCE. Progress Report, September 1, 1972–August 31, 1973. Hyde, R. M. (Oklahoma Univ., Oklahoma City (USA). Dept. of Microbiology and Immunology). 1973. Contract AT(40-1)-3792. 23p. Dep. NTIS $3.25.

Male and female mice were treated with human gamma globulin, and ten days later thymus cells were transferred, along with normal bone marrow cells, to x-irradiated recipients. Although tolerance induction was more difficult to achieve in the female than in the male, the female did not inherit the very high resistance to tolerance induction characteristic of its mother. Lethally irradiated male mice were given intravenous injection of mixture of tolerant and normal cells or mixtures of normal cells and cells taken from donors x-irradiated on the day of cell transfer. Following challenge with human gamma globulin it appeared that unresponsive thymus cells could suppress the responsiveness of normal cells. In other experiments tolerant spleen cells were administered to irradiated mice to determine effects on responsiveness of normal bone marrow and thymus cells. Studies on drug-induced interference with induction of tolerance were conducted using theophylline, mitomycin C, actinomycin D, and puromycin. Studies were also conducted on the relation of time of initiation of graft versus host reaction to the immune status of the recipient. (HLW)

13074 X-CHROMOSOMAL POLYMORPHISM INDUCED BY IRRADIATION IN A LABORATORY RAT STRAIN. Jankovic-Stejin, V.; Kanazir, D.; Becarevic, A. (Boris Kidric Inst. for Nuclear Research, Belgrade). Iugoslav. Physiol. Pharmacol. Acta; 7: No. 1, 51-56(1971).

The cytogenetic anomalies arising in hematopoietic tissue following ionizing irradiation action were studied in male albino rats. (auth)

13075 ACTIVITY OF LEUKOCYTE ALKALINE PHOSPHATASE IN ALBINO RATS FOLLOWING SPLENECTOMY, SPLEEN IRRADIATION, BONE MARROW IRRADIATION, AND APPLICATION OF MYLERAN. Damian-Zelenika, K. (Medical Faculty, Belgrade). Iugoslav. Physiol. Pharmacol. Acta; 7: No. 1, 57-63(1971).

The values of leukocyte alkaline phosphatase were high following splenectomy and selective, single irradiation of bone marrow. Following the irradiation of the spleen the values remained within the range of the normal and in the course of the administration of Myleran there was a sudden enzyme decrease in the granulocytes. (auth)

13076 ANTILYMPHOCYTIC ANTIBODIES AND MARROW TRANSPLANTATION. I. The Effect of Antilymphocyte Serum on Xenogeneic Engraftment. Bau, J.; Thierfelder, S. (Institut fuer Haematologie der Gesellschaft fuer Strahlen und Umweltforschung, Munich). Transplantation; 15: No. 6, vp (June 1973).

Murine bone marrow transferred to rats conditioned with 900 R was rejected after 15 to 20 days. By contrast, a 6-day treatment with rabbit antirat lymphocyte serum of the recipients prior to irradiation resulted in permanent chimaerism as per alkaline phosphatase staining and chromosomal analysis. A mere 750 R produced complete and permanent chimaerism in rats treated with antilymphocyte serum (ALS), a dose insufficient by itself to produce any chimaerism in recipients not treated with ALS. When rat marrow was transferred to mice, rabbit antimouse lymphocyte serum similarly lowered the dose of radiation necessary for xenogeneic engraftment. Thymectomy enhanced the take of the foreign cells in ALS-treated, sublethally irradiated recipients. It was therefore concluded that ALS-derived immunosuppression was primarily responsible for the persistence of hemopoietic xenografts in sublethally irradiated recipients. Implications of the production of the mouse to rat chimaera are briefly mentioned. (auth)

13077 PERMEABILITY OF ARTERIAL INTERNAL ELASTIC LAMINAE IN IRRADIATED MICE. Hampton, J. C.; Rosario, B. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. Exp. Mol. Pathol.; 17: 307-316(Dec 1972).

Mice were exposed to 1500 R x-irradiation and then injected with horseradish peroxidase (HRP) about 2 min prior to sacrifice on days 1, 2, 3, 3.5 and 4 post-exposure. Arteries from various tissues were examined for localization of HRP reaction product. Some arteries showed little or no localization whereas others

showed moderate to intense localization in the internal elastic lamina and elastic tissue in the adventitia, suggesting early damage to dense elastic tissue. (auth)

13078 EFFECT OF THE H-2 GENE DOSE ON THE REJECTION OF SKIN GRAFTS. McKenzie, I. F. C. (Massachusetts General Hospital, Boston). Transplantation; 15: No. 6, 555-563 (Jun 1973).

Significantly shortened survival of skin grafts between mice differing by a single H-2 histocompatibility antigen was observed when the genetic constitution of the donor was homozygous for the antigen tested, rather than heterozygous. The effect was demonstrated for antigens H-2.31 by grafting skin from either B10.D2 or (B10.D2 × A)F_1 hybrid donors and for H-2.32 from B10.BR or (B10.BR × C57BL/10)F_1 hybrid donors to (C57BL/10 × A)F_1 hybrid recipients. Skin grafts obtained from heterozygous donors bearing H-2.31 or H-2.32 persisted for 1 to 3 days longer than grafts obtained from the homozygous donor. Similar observations could also be made using recipients that had undergone nonspecific immunosuppression by virtue of sublethal whole-body irradiation. The delayed rejection of the skin grafts of F_1 origin was probably attributable to the decreased concentration of cell surface H-2 antigens in the F_1 hybrid cells because of a gene dose effect. Absorption studies with spleen cells demonstrated that cells obtained from (B10.D2 × A)F_1 donors carried one-half of the amount of H-2.31 as did cells from B10.D2 mice. Epistatic effects, possibly produced by introducing the A strain genome into the (B10.D2 × A)F_1 donor were excluded, as grafts obtained from (B10.D2 × C57BL/10)F_1 donors were rejected in the same delayed fashion as grafts obtained from (B10.D2 × A)F_1 donors. The effect of H-2 gene dosage, expressed as a lowered cell surface content of H-2 antigens, is probably mediated by an altered reaction between sensitized effector cells and graft antigens, rather than at other stages in the immune response. The fact that two simultaneous skin grafts, one from B10.D2 and another from (B10.D2 × A)F_1 hybrid donors, to the same recipient manifested differential survival is taken as important evidence for this point. In contrast to findings in other species, states of active or passive enhancement did not lead to a significantly greater degree of prolongation of heterozygous grafts compared to homozygous grafts. (auth)

13079 ROLE OF THE HEMOPOIETIC INDUCTIVE MICROENVIRONMENTS (HIM) IN XENOGENIC BONE MARROW TRANSPLANTATION. Rauchwerger, J. M.; Gallagher, M. T.; Trentin, J. J. (Baylor Coll. of Medicine, Houston, TX). Transplantation; 15: No. 6, 610-613(Jun 1973).

Isologous mouse marrow transfused into lethally irradiated mice gave erythroid, granuloid, and megakaryocytic spleen colonies, with an erythroid to granuloid (E : G) spleen colony ratio of 2.2: 1 for 600 colonies in four different mouse strains. Isologous rat marrow transfused into lethally irradiated rats gave rise only to erythroid and undifferentiated colonies (E : G colony ratio = 490: 0). However, rat marrow transfused into lethally irradiated mice gave rise to both erythroid and granuloid colonies (E : G colony ratio approximately 3: 1 for 303 colonies). These results further support the concept of the determining influence of the hemopoietic inductive microenvironments (HIM) with respect to the direction of differentiation of pluripotent hemopoietic stem cells. They indicate that the mouse spleen HIM can influence the direction of differentiation of rat pluripotent hemopoietic stem cells. The fact that hemopoietic colonies of rat origin grew more rapidly in mouse spleens than in rat spleens, and at a rate comparable to isologous mouse spleen colonies, suggests that the mouse HIM, or other host factors, also regulate the rate of growth of spleen colonies. (auth)

13080 COLONY FORMATION IN AGAR BY MURINE PLASMACYTOMA CELLS: POTENTIATION BY HEMOPOIETIC CELLS AND SERUM. Metcalf, D. (Royal Melbourne Hospital, Victoria, Australia). J. Cell. Physiol.; 81: No. 3, 397-410(Jun 1973).

Clonal growth in semisolid agar medium was obtained using cells from 19 of 25 transplanted murine plasmacytomas when the medium was supplemented by whole mouse blood or washed red cells. With different tumors cloning efficiency ranged from 0.01% to 21.6%. With two exceptions, mouse blood did not potentiate colony formation in agar by cells from transplantable myelomonocytic, myeloid, and lymphoid leukemias, reticulum cell sarcomas and fibrosarcomas. The clonal growth of some plasmacytomas was also potentiated by syngeneic thymic, spleen or bone marrow cells. Plasmacytoma colony growth was not stimulated by normal mouse serum but serum from mice injected with endotoxin or polymerised flagellin stimulated colony growth by some plasmacytomas. The active serum factor was not the colony stimulating factor (CSF) and its appearance after antigenic stimulation was not T cell-dependent. Preimmunised mice failed to respond to antigenic stimulation. Whole-body irradiation did not induce a rise in the capacity of serum to stimulate colony formation by plasmacytoma cells. (auth)

13081 RADIOPROTECTIVE EFFECT OF GROUNDNUT OIL. Korgaonkar, K. S.; Ghanekar, S. P. (Cancer Research Inst., Bombay). Indian J. Biochem. Biophys.; 9: 116-118(Mar 1972).

Subcutaneous injections of groundnut oil showed a 10 to 20% reduction in the lethality of rats exposed to a whole-body single dose (900 to 1100 rad) of gamma irradiation. Treatment with this oil also gave marked protection to skin in local irradiation experiments with 220 and 70 kV x rays in rabbits as well as cancer patients. (auth)

13082 GROSS PHYSICAL ANOMALIES IN F_1 PROGENY OF IRRADIATED AND UNIRRADIATED COHO SALMON. Gunstrom, G. K. (Univ. of Washington, Seattle). Trans. Amer. Fish. Soc.; 102: No. 2, 438-442(Apr 1973).

The F_1 progeny of irradiated and unirradiated coho salmon were the object of a study on the occurrence of gross physical anomalies. Experimental lots consisted of 69,000 F_1 progeny of coho salmon that were irradiated during the egg-and-yolk-absorption stage with a 0.1 curie cobalt-60 source at a daily dose of 0.44 R resulting in a total dose of 40 R. Control lots consisted of 95,500 F_1 progeny of unirradiated coho salmon. Anomalies that occurred most commonly in both experimental and control lots were those concerning the operculum, the spinal column, the tail, and the fins. No significant differences were found between experimental and control lots in regard to the occurrence of gross physical anomalies. (auth)

13083 ESTIMATING THE FREQUENCY OF INDUCED DOMINANT LETHAL MUTATIONS IN MICE. II. The Evaluation of a New Method. Soares, E. R. (Jackson Lab., Bar Harbor, ME). J. Hered.; 63: 339-343(1972).

Male mice of the hybrid B6D2F_1 were exposed to 600 R of x irradiation. The standard dominant lethal assay was then carried out simultaneously with a newly developed dominant lethal assay. Both techniques were effective in determining the induction of dominant lethal mutations with the new method approximately 60% as efficient as the classical method. However, the new method appears to have an advantage in being able to detect dominant lethal mutations that occur at or shortly after birth. Further, since the new method permits survival of the nonlethal progeny, additional opportunities for genetic analyses are possible. (auth)

Invertebrates

Refer also to abstract 13016.

13084 BUSULFAN: DEVELOPMENT OF IMPROVED METHODS OF STERILIZING BOLL WEEVILS. Haynes, J. W.; Mitlin, N.; Sloan, C. E.; Dawson, J. R. (Mississippi Agricultural Research Service, Missippi State, MS). J. Econ. Entomol.; 66: No. 3, 619-6 2(Jun 1973).

The standard method of sterilizing Anthonomus grandis Boheman (6-day feeding of 0.1% busulfan, 1-4-butanediol dimethanesulfonate) adequately sterilizes males but does not induce a high degree of sterility in females, and mortality is less than 40% after 2 weeks. Feeding higher concentrations of busulfan alone or lower concentrations of busulfan in combinations with methotrexate, hempa, or apholate for 6 days or less, or feeding 0.1 to 0.2% busulfan followed by low doses of gamma radiation induces virtually complete sterility in both sexes but causes fairly high mortality. A 4-day feeding of 0.2% busulfan + 0.25% methotrexate resulted in complete sterility in females and almost complete sterility in males, and mortality was less than 40% by 3 weeks after treatment. (auth)

13085 REPRODUCTION OF THE MELON FLY: MATING ACTIVITY AND MATING COMPATIBILITY OF FLIES TREATED TO FUNCTION IN STERILE-RELEASE PROGRAMS. Schroeder, W. J.; Chambers, D. L.; Miyabara, R. Y. (Agricultural Research Service, Honolulu, HI). J. Econ. Entomol.; 66: No. 3, 661-663 (Jun 1973).

Mating activity of untreated Dacus cucurbitae Coquillett and of flies irradiated with 10 krad of gamma irradiation at 2 days before adult eclosion and then exposed to semi-anerobic packaging of the pupae began the 4th evening of adult life. However, the untreated population expressed full mating activity the 7th evening, and the treated populations expressed full but reduced mating activity the 8th and 9th evenings. Gamma irradiation thus affected the rate of sexual development and time of peak mating activity, but the semi-anerobic packaging did not compound this injury. Protein had an important effect on the sexual activity of the males; when hydrolyzed protein was omitted from the diet, sexual drive, as expressed by mating, was greatly reduced. (auth)

13086 PINK BOLLWORM: CHROMOSOMAL DAMAGE AND REPRODUCTION AFTER GAMMA IRRADIATION OF LARVAE. Bartlett, A. C.; Lewis, L. J. (Agricultural Research Service, Phoenix, AZ). J. Econ. Entomol.; 66: No. 3, 731-733(Jun 1973).

Late 4th-stage larvae of Pectinophora gossipiella (Saunders) were treated with cobalt-60 gamma irradiation at doses of 0 to 32 krad. Forty percent of the treated male larvae showed chromosomal damage at 2 krad. At 5 krad or higher, 100% of the examined spermatogonial divisions showed chromosomal damage. The percentage of morphologically normal adults mating was reduced by 85% or more at doses above 4 krad for males and 2 krad for females. Some F_1 progeny were produced from crosses between treated and control insects although numbers were generally reduced as compared with controls. Sterility was present in F_1 larvae, and egg production was reduced. Chromosomal aberrations present in the F_1 progeny occurred also in the F_2 but at a lower rate. (auth)

13087 ALMOND MOTH: GAMMA RADIATION EFFECTS ON THE LIFE STAGES. Cogburn, R. R.; Tilton, E. W.; Brower, J. H. (Agricultural Research Service, Savannah, GA). J. Econ. Entomol.; 66: No. 3, 745-751(Jun 1973).

Effects of 6 gamma radiation dosages from 5 to 100 krad on all metamorphic stages of Cadra cautella (Walker) were studied. Development of adults from treated eggs and larvae was prevented by 30 and 20 krad, respectively. Some adults emerged from treated pupae at all levels except 100 krad, but radiation greatly reduced their lifespan. Irradiated adults paired with untreated adults produced fewer eggs than pairs of unirradiated adults, and these eggs had reduced hatch and developmental success. Females were sterilized by 30 krad and males by 100 krad. Progeny of irradiated adults inherited genetic damage that affected their reproductive ability. (auth)

13088 SPERM UTILIZATION IN THE FEMALE RED COTTON BUG. Harwalkar, M. R.; Rahalkar, G. W. (Bhabha Atomic Research Center, Trombay, India). J. Econ. Entomol.; 66: No. 3, 805-806(Jun 1973).

Sterility was induced in male red cotton bugs (Dysdercus koenigü) by exposing adults to 7000 R x rays at 300 R/min. Two groups of females were separately caged with equal numbers of normal and sterile males. At the end of 24 hrs, pairs were removed and kept individually in plastic jars. After the first batch of eggs was laid, the females mated to normal males were paired with sterile males, and females mated to sterile males were paired with normal males. Data on fecundity and egg viability are tabulated. Results showed that mixing of sperm transferred during successive matings had occurred to a certain extent. However, sperm transferred during the most recent mating were involved in egg fertilization. (HLW)

Radionuclide Effects (Internal Source)

Man

13089 (BNWL-SA-4545) STUDY OF SELECTED PARAMETERS AFFECTING THE RADIATION DOSE FROM DRINKING WATER DOWNSTREAM OF NUCLEAR FACILITIES. Denham, D. H.; Soldat, J. K. (Battelle Pacific Northwest Labs., Richland, Wash.). 1973. 32p. (CONF-730603-6). Dep. NTIS $3.75.

From 18th Health Physics Society meeting; Miami Beach, Florida, USA (17 Jun 1973).

A study of some parameters affecting radiation doses received from consumption of water derived from the Columbia River downstream of the Hanford production reactors is described. Included were studies of relative concentrations of radionuclides in water entering and leaving the water treatment plants at Richland and Pasco, Washington; sanitary water at a number of points in Richland; and coffee brewed from sanitary water. The removal efficiencies for the alum-floc water treatment plants studied ranged from 80% for rare-earth nuclides to 10% for ^{51}Cr. The relative concentration of radionuclides (principally ^{24}Na, ^{76}As, ^{122}Sb, ^{239}Np) found within the Richland distribution system was used to estimate the average dose to residents consuming the water. Average GI tract doses calculated for persons residing at each of six locations within the city were $\frac{1}{3}$ to $\frac{1}{2}$ of those calculated for consumption of water leaving the treatment plant. The average dose received, calculated by weighting these six individual doses by the population distribution, yielded 45% of that calculated for consumption of water leaving the treatment plant. Since coffee represents a major liquid intake mode for adults, the potential removal of radionuclides during coffee brewing was studied. The concentrations of radionuclides in the water and coffee brewed from it were not significantly different for those radionuclides contributing the most to the GI tract dose, and hence those doses were not significantly reduced. (auth)

13090 (BNWL-SA-4680) DETECTION OF ^{103}Pd AND ^{51}Cr IN THREE INDIVIDUALS OF DIFFERENT WEIGHT TO HEIGHT RATIOS. Walsh, W. P.; Houston, J. R.; Rieksts, G. A. (Battelle Pacific Northwest Labs., Richland, Wash.). 1973. 26p. (CONF-730439-2). Dep. NTIS $3.50.

From workshop on the in-vivo measurements of heavy elements; Los Alamos, New Mexico, USA (24 Apr 1973).

Three subjects who had inhaled polystyrene particles containing ^{103}Pd and ^{51}Cr were examined with 7 different counting systems. Three of these systems were whole-body counting systems utilizing large sodium iodide scintillation crystals. One of these systems was a lung counter system also utilizing sodium iodide crystals as well as the so-called phoswich detector consisting of sodium iodide and cesium iodide scintillation crystals. The subjects were also examined with a germanium-lithium solid state detector system. However, the data obtained on this GeLi was taken for development purposes only. The seventh system used to examine these individuals consisted of a 1 mm thick × 2" diameter sodium iodide crystal. This detector was used only to locate the regions of maximum activity. Provisional estimates of the amounts and activity of each radionuclide present were obtained two to three weeks following the incident. (CH)

13091 (LBL-1799) REPORT OF THE BIOASSAY LABORATORY 1969 TO 1972. Low-Beer, A. G.; Sargent, T. W.; Wright, S. R.; Buckley, B. C.; Yaeger, D. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

Activities of the Bioassay Program, including whole-body counting of laboratory employees, from July 1, 1969, to June 30, 1972, are reported. Results of routine monitoring and investigation of cases of suspected exposure to radionuclides are presented. The scope and accomplishments of the research and development program are described. A number of exposure cases were also referred for investigation by outside agencies and results of these investigations are presented. Routine monitoring typically includes radiochemical analysis of urine and feces for gross alpha and gross beta activity, and gamma spectrometry of samples. (CH)

Animals

Refer also to abstracts 12869 and 13101.

Nuclide Kinetics and Toxicology

Man

13092 (AAEC/E-247) RADIATION DOSE INCURRED FROM THE ADMINISTRATION OF "SKELTEC". Hetherington, E. L. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The Medical Internal Radiation Dose Committee method, based on computer calculations of radionuclide decay, was used to calculate the radiation dose to the skeleton, bone marrow, kidneys, liver, and whole body for a 10 mCi dose of ^{99m}Tc in the form of Skeltec, a thermostable technetium compound for bone scanning. Activity concentration in these organs were compared with both published and unpublished results of phantom, biopsy, and animal experiments. (CH)

13093 RAPID DETERMINATION OF THE EARLY ^{99m}Tc-PERTECHNETATE THYROID UPTAKE USING A MULTICHANNEL ANALYZER. Castronovo, F. P. Jr.; Ring, R. III (Massachusetts General Hospital, Boston). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 298-299(May 1973).

A method is described that reduces the usual period of 45 to 60 min necessary for the determination of ^{99m}Tc-pertechnetate thyroidal uptake to 10 to 15 min and that does not involve the extended use of a gamma camera. A multichannel analyzer consisting of a dual analog to digital converter, word memory, and oscilloscope interfaced to a magnetic tape recorder was used. (UK)

Animals

Refer also to abstracts 12868, 12870, and 15168.

13094 (ANL-7970, pp 121-125) METABOLIC AND THERAPEUTIC STUDIES OF PLUTONIUM AND AMERICIUM. Lindenbaum, A.; Rosenthal, M. W.; Baxter, D. W.; Egan, N. E.; Kalesperis, G. S.; Moretti, E. S.; Russell, J. J. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Progress is reported on the removal of long-term deposits of plutonium in the mouse liver by DTPA, glucan, and related compounds. When given as an adjunct to DTPA, glucan did not increase or modify the effects of DTPA. Other related substances, isosclerotan, pyran copolymer, and Triton WR 1339, were tested. These adjuncts to DTPA therapy removed additional ^{239}Pu from

the liver. Quantitative autoradiography was used in studies on localization of liver plutonium. Other studies were conducted on effects of physicochemical state of plutonium on lifetime pathological changes in mice. (HLW)

13095 (ANL-7970, pp 206-208) CESIUM-137-LATE EFFECTS OF SINGLE INTRAVENOUS INJECTIONS IN BEAGLES. Fritz, T. E. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Since the previous report of last year an additional eleven dogs died: eight of these died of neoplasms; two had endometritis; and one had advanced hepatic degeneration and anemia. Data from the 122 colony controls and the 40 ^{137}Cs-injected dogs were used to construct life tables and compare the survival of the control and treated groups. It was concluded that the late effects of injected ^{137}Cs are hepatic degeneration and an increased incidence of soft tissue tumors; the survival time is also decreased. (HLW)

13096 (LF-tr-75) BEHAVIOR OF INTRATRACHEALLY ADMINISTERED RADIOACTIVE CERIUM FLUORIDE ($^{144}CeF_3$) IN THE LUNGS. Ivanov, A. E.; Gorel'chik, K. I. Translated from Med. Radiol.; 10: No. 7, 65-69(1965). 9p. Dep. NTIS $3.00.

Cerium-144-labeled cerium fluoride was administered intratracheally to chinchilla rabbits. Scanning of the thorax was conducted after administration at the following time intervals: 15 min, 4, 8, 16, 32, 60, 120, and 420 days. The ^{144}Ce was distributed unevenly and was concentrated in the zone of the radix pulmonis. Decrease in ^{144}Ce activity in the lungs occurred in two phases. The first phase proceeded rapidly and biological mechanisms of purification predominated. The second phase developed slowly and a certain equilibrium between removal and radioactive decay occurred. (HLW)

13097 (LF-tr-76) ROUTES OF CESIUM-137, STRONTIUM-89, AND CERIUM-144 ABSORPTION. Buldakov, L. A. [nd]. Translated from pp 82-87 of Raspredelenie Biologicheskoy Deistvie i Migratsiya Radioaktivnykh Izotopov, 1961. 13p. Dep. NTIS $3.00.

Cesium-137, ^{89}Sr, and ^{144}Ce were administered to dogs subcutaneously, intraperitoneally, intravenously, and orally. Blood and lymph samples were taken from 30 min to 6 hrs later and results were tabulated. Cesium-137 and ^{89}Sr were absorbed from the site of administration primarily through blood vessels while ^{144}Ce was absorbed primarily through lymph vessels. Cesium-137 was most quickly removed from the peripheral blood while ^{144}Ce was most slowly removed. The predominant absorption of ^{137}Cs and ^{89}Sr into blood capillaries of ^{144}Ce into lymph vessels was evidence of the different physical and chemical states of the elements. Absorption of ^{137}Cs, ^{89}Sr, and ^{144}Ce from the gastrointestinal tract comprised 100, 50, and 0.05% of the amount administered respectively. (HLW)

13098 (LF-tr-77) DISTRIBUTION OF CERIUM-144 IN ANIMALS. Moskalev, Yu. I.; Kulikova, V. G. [nd]. Translated from pp 53-78 of Raspredelenie Biologicheskoy Deistvie i Migratsiya Radioaktivnykh Izotopov, 1961. 46p. Dep. NTIS $4.50.

Cerium-144 was administered intraperitoneally or intravenously to guinea pigs, mice, rabbits, cats, dogs, and frogs. At specific intervals following administration, the animals were killed and the activity in various organs was determined. The pattern of distribution of ^{144}Ce was identical in the visceral organs of various animals. Relatively greater quantities were deposited in the liver and spleen and relatively smaller quantities in the kidneys and skeleton. The livers of frogs contained 3 to 4 times less ^{144}Ce, and the skin 20 to 50 times more than those of warm-blooded animals. The species and age of the animal exerted a substantial influence on the amount of deposition in the skeleton. The lowest concentration appeared in the brain. (HLW)

13099 (LF-tr-78) LONG-TERM EFFECTS ON THE RAT OF RADIOACTIVE CERIUM ADMINISTERED VIA THE GASTROINTESTINAL TRACT. Moskalev, Yu. I.; Strel'tsova, V. N. Translated from Med. Radiol.; 1: No. 6, 14-20(1956). 14p. Dep. NTIS $3.00.

Cerium-144-labeled cerium chloride was administered to rats in drinking water. Observations were made on life span, weight, hematology, and pathology. Mild leukopenia with relative neutrophilia developed in animals that received the maximum quantity of ^{144}Ce for 100 days. Other changes observed were: severe necrotic gastroenterocolitis with atrophy of the spleen and lymphoid tissue; development of tumors of the gastrointestinal tract, lungs, mammary glands, and endocrine glands; nephrosclerosis; dystrophy of the liver; and non-specific inflammatory processes. Long-term intake of ^{144}Ce into the organism via the gastrointestinal tract was ten times more effective than single intake according to the criterion of life span. (HLW)

13100 (RFP-2054) ELECTRON DIFFRACTION STUDY OF PLUTONIUM OXIDE PARTICULATES IN DOG LYMPH TISSUE. Hillyer, R. F.; Dagle, G. E. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 15 Jun 1973. Contract AT(29-1)-1106. 7p. Dep. NTIS $4.00.

Popliteal lymph-node sections from beagle dogs were examined with the electron microscope in order to define localized particulates. By means of autoradiography, particulates in the lymph tissue had been determined previously to be alpha emitters (radioactive). However, with electron diffraction, the particulates have been identified as plutonium oxide (PuO_2). (auth)

13101 (UR-3490-321) BRIEF DESCRIPTION OF RESEARCH PAPERS ACCEPTED FOR PUBLICATION DURING 1972. Annual Report. Neuman, W. F. (Rochester Univ., N. Y. Atomic Energy Project). 15 May 1973. Contract AT(11-1)-3490. 95p. Dep. NTIS $5.45.

Summaries of 126 papers accepted for publication during 1972 are presented in the following categories: internal emitters and mineral metabolism; aerosols; inhalation; cancer research; toxicology and membrane function; chemical toxicity; animal radiobiology; radiation toxicity; molecular genetics; and cellular and molecular radiobiology. (ERB)

13102 PLACENTAL TRANSFER OF INERT GASES. Radioautographic Studies With Krypton-85 in Pregnant Rat. Bergeron, M.; Fontenelle, A.; Sternberg, J. (Univ. of Montreal). Int. J. Appl. Radiat. Isotop.; 24: No. 5, 295-298(May 1973).

Preliminary results are reported on the placental transfer of ^{85}Kr in pregnant rats. The radioactive gas was injected into the iliac artery and the tissue distribution determined by radioautographies of tissue sections taken 5, 15, 30, 45, and 60 sec after injection. Radioautographs of a section of the uterine sac are shown. The results obtained are discussed. The uneven distribution of ^{85}Kr throughout the placenta corresponds to the labyrinthic structure of this organ in the rat; it also suggests that the dilution of the inert gas into the placental blood pool is not homogeneous. The absence of krypton in the fetal compartment even 60 sec after injection to the mother is considered and the possible extrapolation of the information to humans discussed. (UK)

13103 RADIOACTIVITY IN JUVENILE COLUMBIA RIVER SALMON: A MODEL TO DISTINGUISH DIFFERENCES IN MOVEMENT AND FEEDING HABITS. Romberg, G. P.; Renfro, W. C. (Oregon State Univ., Corvallis). Trans. Amer. Fish. Soc.; 102: No. 2, 317-322(Apr 1973).

The ^{32}P specific activities and ^{65}Zn concentrations were measured in juvenile salmon collected from the Columbia River during winter and spring of 1969. An environmental uptake study involving marked juvenile chinook salmon indicated that ^{32}P specific activity values reach a maximum sooner than values for ^{65}Zn concentration. The uptake study also suggested a short lag period before hatchery fish released to the Columbia River began rapid uptake of ^{32}P and ^{65}Zn. A graphical model based on ^{32}P specific activities and ^{65}Zn concentrations was constructed that allows fish to be classified and differentiated with regard to their past feeding or movement behavior. Use of the model indicated that some hatchery fish released to the river either had feeding behavior unlike other hatchery fish or were not in the Columbia River the entire time from release until collection. Application of the model to a sample of 24 unmarked juvenile salmon collected from the Columbia River revealed several different groups of fish. (auth)

Microorganisms

13104 (ANL-7970, pp 174-176) EFFECTS OF RADIOISOTOPE DECAY IN MICROORGANISMS. Krisch, R. E.; Ley, R. D. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

Phosphorus-32 and ^{33}P were compared with regard to the induction of lethals in phage T4 and the induction of double-strand breaks in T4 DNA. Sensitivity of phage stored at –196°C to killing by either isotope was unaffected by AET during storage, in contrast to a marked protective effect from AET for phage stored at +4°C. When T4 phage were stored at –196°C, at least 75% of double-strand breaks in DNA, as well as most lethalities, from ^{32}P decay were induced by nuclear recoil. Radiophosphorus decay in phage SP82G inhibited the transmission of genetic information into the lost cell; this effect was much greater when the phage were stored at +4°C than at –196°C. Preliminary results indicated that every ^{125}I decay in phage T4 carried a double-strand break, but that only half of all decays were lethal. (HLW)

New Tracer Techniques

Refer also to abstracts 12994, 13059, 15126, and 15147.

13105 (ANL-7970, pp 164-166) FOLIC ACID MALABSORPTION. Application of Stable Isotope Labeled Folate in the Clinical Diagnosis of Vitamin B Deficiency. Hachey, D. L.; Rosenberg, I. H.; Klein, P. D. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

A deuterium-labeled folic acid was used in which the label was placed in the para-aminobenzoic acid portion of the molecule. Graphs are presented to show mass spectra and isotope dilution curves for PABA and PABA-d_2. It was concluded that deuterium-labeled folic acid should provide a sensitive test for folate malabsorption. (HLW)

13106 DIAGNOSTIC AND THERAPEUTIC MEDICAL APPLICATIONS FOR ISOTOPES. Atkins, H. L. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 16: 50-51(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13107 RADIOIMMUNOASSAY FOR AVIAN C-TYPE VIRUS GROUP SPECIFIC ANTIGEN: DETECTION IN NORMAL AND VIRUS TRANSFORMED CELLS. Stephenson, J. R.; Wilsnack, R. E.; Aaronson, S. A. (National Cancer Inst., Bethesda, MD). Journal of Viralogy; 11: No. 6, 893-899(Jun 1973).

A radioimmunoassay was developed for detection of avian C-type virus (30,000 mol wt) group-specific (gs) antigen. The method is 10- to 1,000-fold more sensitive than immunological methods previously available. By the radioimmunoassay technique, normal chicken embryo cells, which have previously been classified as gs negative or weakly gs positive, contain clearly detectable amounts of gs antigen. The assay was used to study the effect of chemical induction and superinfection by mammalian C-type viruses on the expression of avian gs antigen in mammalian cells nonproductively transformed by avian sarcoma viruses. (auth)

13108 ISOTOPIC TECHNIQUES IN HUNGARIAN AGRICULTURE. Szaloczy, B. (Mezogazdasagi es Elelmezesuegyi Miniszterium, Budapest). Izotoptechnika; 16: No. 4, 186-198 (Apr 1973). (In Hungarian).

A survey of the almost two-decade development of the application of radioisotopes and radiations in the research on plant cultivation, soil science, agrochemistry, plant protection, veterinology, animal husbandry, food storage, and food preservation is presented. (auth)

13109 RADIONUCLIDES IN NEPHROLOGY. Proceedings of An International Symposium, New York, NY, January 25-27, 1971. Blaufox, M. D.; Funck-Brentano, J. L. New York; Grune and Stratton, Inc. (1972). 384p. (CONF-710121-). $21.50.

The applications of radioisotopes in nephrology are discussed under the following headings: renal blood flow; radioimmunoassay; metabolism and body composition; autoradiography; clearance; imaging procedures; and radionuclide renography. (ERB)

MATERIALS

13110 (EUR-4820(Vol. 6)(Pt. L), pp 149-160) SOME CONCEPTS OF NONLINEAR THERMO-VISCOELASTICITY. Bychawski, Z.; Fox, A. (Technical Univ., Krakow). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Formulation of a constitutive equation for structural nonlinear visco-elastic material in which temperature appears as physical variable is discussed. Such conditions are found in materials that find application in reactor technology and are exposed to mechanical and thermal loading. The basic principles of derivation such a constitutive equation are founded on concepts given by Bychawski and Fox. In addition to the complex nonlinear viscoelastic behavior, the influence of a temperature field depending on time is introduced. It is found that, in order to satisfy the condition of time compatibility, some restrictions should be put on the separated physical members of differential constitutive form. These are crossing relations which, if satisfied, enable one to consider the last form to be a total differential. Thus, a complex constitutive equation is found together with additional constitutive relations. (auth)

13111 (EUR-4820(Vol. 6)(Pt. L), pp 489-501) THEORY OF STEADY PLASTIC CYCLES IN STRUCTURES. Mroz, Z. (Inst. of Fundamental Problems of Tech., Warsaw). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Steady plastic cycles are shown to constitute limit states of transitory processes of plastic deformation under cyclically varying loads and external temperature. Uniqueness of steady cycles is discussed, and it is shown that superposed fixed displacements on the structure can not affect the form of the steady cycle. Starting from the notion of statically and kinematically admissible cycles, some inequalities are proved; these may be useful in finding an approximate solution to the steady cycle. (auth)

13112 (EUR-4820(Vol. 6(Pt. L), pp 503-517) SHAKEDOWN DESIGN OF STRUCTURES WITH TEMPERATURE-DEPENDENT ELASTIC MODULI. Koenig, J. A. (Inst. of Fundamental Problems of Tech., Warsaw). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An extension of the Melan shakedown theorem for the case of temperature-dependent elastic moduli is presented. A new formulation of the appropriate shakedown theorem requires modified methods of solving problems. An explicit relation between stresses and plastic deformation is used in order to determine possible ranges of elastic response of structures. Examples of calculations of clamped bars, plates, and thick-walled shells show that the influence of the Young modulus variation usually does not exceed a few percent. (auth)

13113 (EUR-4820(Vol. 6)(Pt. L), pp 535-566) APPLICATION OF FINITE-ELEMENT METHOD TO FRACTURE MECHANICS. Miyamoto, H. (Tokyo Univ.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Some examples in which the finite-element method has been applied successfully to fracture mechanics are presented. First, the stress intensity factor of the semi-elliptical surface flaw in a rectangular plate is obtained by the crack opening displacement. Second, elastic-plastic behavior near the tip of double-edged cracks in a rectangular plate is analyzed three-dimensionally, and the difference between the state of stress in the center plane and the surface of the plate is discussed. Further, two-dimensional analysis of the cracked plate under cyclic loadings is carried out, and the alternating plastic zone and the deformation of the crack surface are obtained. The above analyses are treated for the homogeneous and isotropic body. Next, inhomogeneity due to crystal grains is considered. Coarse-grained aluminum sheet under tension is analyzed considering the orientation of each grain, and the initiation of the slip lines is estimated. The results agreed well with experiment. Finally, the above method is combined with the Monte Carlo method, and Young's modulus and Poisson's ratio are obtained. (auth)

13114 (EUR-4820(Vol. 6)(Pt. L), pp 567-585) INFLUENCE OF STRUCTURAL DAMAGE UPON THE FRACTURE TOUGHNESS OF METALS. Ohlson, N. G. (Royal Inst. of Tech., Stockholm). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In most elastic-plastic materials, a propagating crack is preceded by plastic deformation occurring in a zone in front of the crack tip. This deformation can be regarded as a structural damage that facilitates the growth of the crack. If temperature and deformation speed are properly selected, no plastic zone of that kind will appear spontaneously. Then, the size of the zone can be determined beforehand. For instance, measuring the fracture toughness at high strain rate in Mode I, a very sharp plastic zone near the crack is obtainable by steady-state loading in Mode III. In this way, fracture toughness for some structural steels, brass, and aluminum alloys was studied as influenced by: a) general yielding, b) local yielding in front of the crack, c) residual deformation due to loading history, and d) creep damage. These experiments show that the fracture toughness decreases as a function of plastic strain, when this is comparatively small, then gradually assumes a constant value. If the yielding is limited to a small area near the crack tip, the plastic zone must be very sharp to produce any noticeable effect on the toughness. The determination of the relation between toughness and plastic strain might become an instrument for giving approximate solutions to problems where linear fracture mechanics is not to be applied because the spontaneous plastic zone is not sufficiently small. (auth)

13115 (EUR-4820(Vol. 6)(Pt. L), pp 637-653) SURVEY AND EVALUATION OF THE FINITE-ELEMENT METHOD IN LINEAR FRACTURE MECHANICS ANALYSIS. Gallagher, R. H. (Cornell Univ., Ithaca, NY). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Approaches to finite-element fracture mechanics analysis are classified and reviewed. Four categories are defined for linear fracture mechanics: direct, energy-based, superposition, and singularity-function methods. Advantages and limitations of the respective methods are discussed and avenues of approach to more efficient and accurate analyses are identified. A separate section is devoted to inelastic fracture mechanics analysis. (auth)

13116 NEUTRON SCATTERING AS A METHOD FOR FERMI SURFACE INVESTIGATIONS. Dieterich, W. (Institut Max von Laue-Paul Langevin, Garching, Ger.). Solid State Commun.; 12: No. 11, 1191-1195(1 Jun 1973).

High-T_c A15 compounds, for example V_3Si or Nb_3Sn, are suggested as suitable materials for which Fermi surface investigations by means of thermal neutron scattering might be possible. The structure of the differential neutron-d-electron cross section at small scattering angles is connected in a simple way with parameters defining the Fermi surface of the linear chain model. The magnitude of the cross section is estimated and compared with the phonon background. (auth)

13117 COMPUTER SIMULATION IN SOLID-STATE PHYSICS. Bullough, R. (Atomic Energy Research Establishment, Harwell, Eng.). pp 323-336 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Various applications of computer simulation methods applied to the study of defects in crystalline solids are surveyed. The discussion emphasizes the physical significance of the various applications rather than the computational techniques involved. (auth)

Ceramics and Cermets

Refer also to abstracts 13170, 13172, 13256, 13257, 13324, 13373, 13383, 14415, 14416, 14418, 14531, 14548, 14559, and 14564.

13118 (GULF-GA-B-12409). THERMOCHEMICAL STABILITY OF IRRADIATED HTGR FUEL PARTICLES. Scott, C. B. (Gulf General Atomic Co., San Diego, Calif.). 1 May 1973. Contract AT(04-3)-167. 63p. Dep. NTIS $5.25.

The integrity of the coatings on HTGR pyrolytic-carbon-coated fuel particles is influenced by thermochemical interaction between the fuel kernel and pyrolytic-carbon coatings. During power operation, a temperature gradient exists across the coated particle, and interaction between the fuel kernel and coating can take

the form of unidirectional migration of the fuel kernel into the hot side of the particle coating. Post-irradiation thermal-gradient-annealing studies were conducted on pyrolytic-carbon-coated UO_2, ThO_2, UC_2, and ThC_2 particles irradiated to fast neutron fluences of 2 to 8×10^{21} n/cm^2 (E > 0.18 MeV) at temperatures up to 1525°C. Gamma-spectrometry and electron-microprobe analyses were utilized to evaluate the fission-product redistribution and release from the coated particles during annealing. Data on the temperature dependence of fuel kernel migration in carbide particles were obtained. A qualitative comparison of the thermal stability of oxide and carbide fuel particles is presented. (auth)

13119 (LA-5147) SPECIAL GRAPHITES AND CARBIDE–GRAPHITE COMPOSITES DEVELOPED AT LASL. Riley, R. E. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 64p. Dep. NTIS $5.45.

Well-characterized materials containing either TaC and graphite or pure graphite were fabricated utilizing powder-metallurgy techniques that included hot pressing or hydrostatic pressing and subsequent high-temperature heat treatment. Physical structure and thermal properties were investigated, particularly thermal-stress fracture resistance. It was found that well-controlled reproducible materials manifesting an excellent distribution of carbide in the graphite matrix could be fabricated utilizing either technique. Thermal properties were affected significantly by the size and relative amounts of TaC and graphite used in the composite. Data on dynamic elastic modulus, thermal expansion, thermal conductivity, and thermal-stress fracture resistance are presented. (auth)

13120 (LA-UR-73-694) ENTHALPIES OF FORMATION OF SOME GADOLINIUM CARBIDES. Huber, E. J. Jr.; Holley, C. E. Jr.; Krikorian, N. H. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 7p. (CONF-730901-1). Dep. NTIS $3.00.

Determinations of the enthalpies of formation of Gd_3C, Gd_2C_3, and GdC_2 are presented. The measurements were made using oxygen bomb combustion calorimetry methods. The results are regarded as preliminary because of uncertainties in the analysis of the combustion products. (JRD)

13121 (N-73-16638) THEORETICAL ANALYSIS OF SWELLING CHARACTERISTICS OF CYLINDRICAL URANIUM DIOXIDE FUEL PINS WITH A NIOBIUM–1-PERCENT-ZIRCONIUM CLAD. Saltsman, J. F. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb 1973. 45p. (NASA-TM-X-2717; E-7135). NTIS.

The relations between clad creep strain and fuel volume swelling are shown for cylindrical UO_2 fuel pins with a Nb–1Zr clad. These relations were obtained by using the computer code CYGRO-2. These clad-strain–fuel-volume-swelling relations may be used with any fuel-volume-swelling model, provided the fuel volume swelling is isotropic and independent of the clad restraints. The effects of clad temperature (over a range from 118 to 1642°K), pin diameter, clad thickness, and central hole size in the fuel are investigated. In all calculations the irradiation time was 500 hours. The burnup rate was varied. (auth)

13122 EXPERIMENTAL DETERMINATION OF THE FUSION SPECTRUM IN GRAPHITE. Frein, J. (Univ. of Oklahoma, Norman); Draper, E. L. Jr. Trans. Amer. Nucl. Soc.; 16: 9-10 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13123 TEMPERATURE-DEPENDENT HALL EFFECT MEASUREMENTS IN ALUMINA. Green, B. A. (Intelcom Rad Tech, San Diego, CA); Davis, M. V. Trans. Amer. Nucl. Soc.; 16: 75-76(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13124 APPARATUS TO SIMULATE IN-REACTOR TRANSIENT HEATING CONDITIONS IN OXIDE FUEL COLUMNS. Wrona, B. J.; Roberts, J. T. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 77(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13125 CARBIDE FUEL DEVELOPMENT: A SUMMARY REPORT. Strasser, A.; Montgomery, M. (Gulf United Nuclear Fuels Corp., Elmsford, NY). Trans. Amer. Nucl. Soc.; 16: 78-79(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13126 LABORATORY TESTS OF A TERNARY OXIDE FUEL ELEMENT FOR A TREAT CONVERTER. Rough, F. A.; McCuaig, F. D.; Schumar, J. F.; Thresh, H. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 118(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13127 FISSION GAS SWELLING AND LONG-RANGE MIGRATION AT LOW TEMPERATURES. Dollins, C. C. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 16: 118-119(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13128 IN-PILE THERMAL CONDUCTIVITY OF FUEL OXIDE: UO_2 PELLETS AND VIPAC: UO_2–PuO_2 PELLETS AND SOL-GEL. Calza, A.; Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U. V.; Rotoloni, R. P. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 16: 119-120(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13129 RELEASE OF FUEL AND FISSION PRODUCTS FROM EARLY-IN-LIFE $(Pu,U)O_2$ FUEL FAILURES. Bohaboy, P. E.; Craig, C. N.; Regimbal, J. J. (General Electric Corp., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 122(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13130 EFFECT OF OXYGEN AVAILABILITY ON THE EXPANSION RATE OF FAILED $(Pu,U)O_2$ FUEL RODS. Plumlee, D. E.; Bohaboy, P. E.; Craig, C. N. (General Electric Corp., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 123(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13131 EFFECTS OF MATERIAL POROSITY ON PRESSURE GENERATION. Boade, R. R. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 16: 356-357(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13132 SILICON NITRIDE FOR MICROELECTRONIC APPLICATIONS. Part 2. Applications and Devices. Milek, J. T. Handbook of Electronic Materials. Volume 6. New York; Plenum Publishing Corporation (1972). 122p.

This volume surveys the use of silicon nitride in the semiconductor and microelectronics industries. Diffusion mask applications, glass-to-metal seals, passivation applications, isolation, memory devices, capacitors, radiation-hardening applications (a separate abstract was prepared), and miscellaneous devices and applications are considered in turn. (123 references) (DLC)

For an abstract of an individual section see: 12966.

13133 ERBIUM HECTOBORIDE. Nichols, M. C.; Mar, R. W. (Sandia Labs., Livermore, CA). Contract AT(29-1)-789. Inorg. Chem.; 12: No. 7, 1710-1711(Jul 1973).

The preparation and characterization of single-phase erbium hectoboride, are reported. Electron microprobe and wet chemical analyses were performed to determine more exactly the erbium to boron ratio. Seven ingots with compositions ranging from 93 to nearly 100 mole % boron were prepared and cursorily examined by metallographic analysis. The indexed x-ray diffraction pattern for ErB_{85} is tabulated. The structure was found to be face-centered cubic with $\alpha_0 = 23.440$ and $\sigma = 0.003$ A. (JGB)

13134 EROSION TESTS OF TUNGSTEN CONTAINING DISPERSED INCLUSIONS OF ZIRCONIUM DIOXIDE. Antsiferov, V. N.; Shafit, I. A. (Perm Polytechnic Inst., USSR). Fiz. Khim. Mekh. Mater.; 8: No. 6, 104-105(1972). (In Russian).

Significant increases in the resistance to erosion were noted in W–Ni and W–Ni–Cu alloys containing added ZrO_2 (0, 1, 3, and 10% ZrO_2). (auth)

13135 COMPOSITION CONTROL IN THE MANUFACTURE OF MIXED URANIUM AND PLUTONIUM OXIDES AND CARBIDES BY SINTERING. Dean, G.; Lorenzelli, R. (CEN, Fontenay-aux-Roses, France). Bull. Soc. Fr. Ceram.; No. 97, 39-53(Oct 1972). (In French).

Sintered mixed oxide $(U,Pu)O_2$ or mixed carbide (U,Pu)C fuel pellets are used in fast breeder reactors. The manufacturing processes used enable the composition of the products (O/(U + Pu) ratio for oxides and (C + N + O)/(U + Pu) ratio for carbides) and their densities to be established. The procedures used were developed from thermodynamic and kinetic studies, the principal results of which are reviewed. (FR)

13136 PROTON NUCLEAR MAGNETIC RESONANCE IN THE ZIRCONIUM–SCANDIUM–HYDROGEN SYSTEM. Shcherbak, V. I.; Bykov, V. N.; Karabash, V. A.; Kazarnikov, V. V. Fiz. Metal. Metalloved.; 35: No. 2, 227-232(1973). (In Russian).

The phase composition, paramagnetic susceptibility, and Knight shift of protons were investigated in the Zr–Sc–H system. The

negative sign and substantial value of the Knight shifts were associated with the presence of an exchange interaction of the 1s-electrons, having a significant density at the protons, with the electrons of the metals. (tr-auth)

13137 QUASI-TERNARY SYSTEM Mo–TiC–ZrC. Zakharov, A. M.; Arbuzov, V. K.; Korchagin, P. A.; Umanskii, A. M. Izv. Akad. Nauk SSSR, Metal.; No. 2, 230-233(1973). (In Russian).

The phase diagram was investigated for alloys in the Mo–TiC–ZrC system that contained up to 3% TiC and ZrC. The mutual solubility of carbides TiC and ZrC in Mo was determined at 1200 to 2100°C for sections with TiC : ZrC ratios of 3 : 1, 1 : 1, and 1 : 3. The techniques involved included optical pyrometry, x-ray diffraction, and microhardness measurements. The carbides of Ti and Zr were in equilibrium with a Mo α-solid solution and possessed a variable solubility in Mo. (tr-auth)

13138 SOLID SOLUTION OF CARBON AND OXYGEN IN α–Zr. Alyamovskii, S. I.; Zainulin, Yu. G.; Shveikin, G. P.; Gel'd, P. V.; Bausova, N. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 76-78(1973). (In Russian).

Pure Zr, ZrO_2, and carbon black were used to synthesize various compositions in the Zr–C–O system in a study of the solubility of C and O in α–Zr. The data indicated that the region of homogeneity of the solid solution α–ZrC_xO_y at 1500°C was rather small and did not extend beyond the limits of Zr–$ZrC_{0.02}$–$ZrO_{0.41}$ in the triangular composition diagram. (KSW)

13139 SPIN-ECHO STUDIES OF EuO AND EuS. Raj, K. (Fordham Univ., New York); Burch, T. J.; Budnick, J. I. Int. J. Magn.; 3: No. 4, 356-357(Dec 1972).

The hyperfine interactions at the ^{153}Eu nuclei in ordered EuO and EuS were measured and it was found that there is a striking frequency dependence of the effective spin–spin relaxation time. The existing discrepancy between absorption spectra and spin-echo spectra is removed by correcting the spin-echo spectra for this effect. (auth)

13140 MAGNETIC SUSCEPTIBILITY AND MAGNETIC RELAXATION IN METAL–HYDROGEN SYSTEMS BASED ON GROUP-IV TRANSITION METALS. Khodosov, E. F.; Shepilov, N. A. (Donetsk Physical-Technical Inst., USSR). Fiz. Metal. Metalloved.; 35: No. 2, 441-443(1973). (In Russian).

The state of hydrogen in Ti–H, Zr–H, and Hf–H systems was investigated through measurements of the magnetic susceptibility and spin–lattice relaxation in their dependence on the temperature and hydrogen concentration. Purity of the samples was such that ferromagnetic impurities (Fe, Co, Ni) < 0.02 wt %. The data support the metallic state of H^+ as opposed to the hydride ion state, H^-. (KSW)

13141 ORDER–DISORDER (LAMBDA) TRANSITION IN URANIUM DIOXIDE AND OTHER SOLIDS OF THE FLUORITE TYPE OF STRUCTURE. Bredig, M. A. (Oak Ridge National Lab., TN). Colloq. Int. Cent. Nat. Rech. Sci.; No. 205, 183-191(1972).

The occurrence of a lambda transition in solid ionic compounds AB_2 having the simple fluorite (or antifluorite) type of crystal structure was established lately through high-temperature calorimetric heat-content measurements on $SrCl_2$ and K_2S (Dworkin and Bredig, 1963 to 1968). This and consideration of other properties (electrical conductance, ion self-diffusion) and of the particular geometry of the fluorite structure led to the postulate that the cooperative phenomenon of B ion disordering, essentially complete, i.e., far beyond the formation of merely a limited number of non-interacting Frenkel defects, was a general characteristic of such compounds including refractory dioxides. Correspondingly this transition is in fact found not only in UO_2 ($T_{tr} \approx 2{,}670$°K) as discussed in greater detail, but also in CaF_2, SrF_2, BaF_2, PbF_2, and Na_2O. It is predicted for ThO_2, Na_2S, $Li_2(NH)$ and most other ionic compounds having this type of structure. Correlation of excess entropy with the relative sizes of the A and B ions, i.e., of the characteristic lattice voids and the B ions entering them on disordering, is found, provided a more recent set of ionic crystal radii is used in place of the conventional one. (32 references) (auth)

13142 PECULIARITIES OF CHANGES OF MICROSTRUCTURE OF REFRACTORY MATERIAL IN PRESENCE OF A TEMPERATURE GRADIENT. Mayauskas, Yu. S.; Grinyute, G. A.; Dauknis, V. I.; Ivanauskas, P. I.; Abriatis, R. I. (Inst. of Physical and Technical Problems of Energetics, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 3: 141-148(1972). (In Russian).

An analysis is presented of microstructural changes on the surface of MgO and ZrO_2-based refractories during one-side heating at temperatures higher than the respective sintering temperatures. The heating was performed by radiation and by high-temperature gas combustion. A notable ordering of grains was found, under the influence of temperature gradient, towards the heated side. The rate of ordering is determined by the heated surface temperature, temperature gradient in specimen, and by prolongation of heating. (auth)

13143 X-RAY STUDIES IN THE SYSTEM $BaTiO_3$–MoO_3. Chincholkar, V. S. (Inst. of Science, Nagpur, India). Curr. Sci. (India); 42: No. 12, 420(20 Jun 1973).

The effects of MoO_3 additions (up to 3.50 mole %) on the structure of $BaTiO_3$ were studied. The lattice parameter c/a ratio increases from 0.989 for pure $BaTiO_3$ to 0.995 for 2.00 mole % MoO_3, then drops to a constant value of 0.993 for 2.5 to 3.5 mole % MoO_3. Results can be understood if MoO_3 introduces BaO defects through the formation of $BaMoO_4$; at larger MoO_3 contents, the perovskite structure no longer tolerates additional vacancies and a rutile phase begins to crystallize beyond 2 mole % MoO_3. (DLC)

13144 REACTION OF Tb_4O_7 WITH Bi_2O_3. Nasonova, S. N.; Serebrennikov, V. V. Zh. Neorg. Khim.; 18: No. 6, 1700-1702 (Jun 1973). (In Russian).

The compound $TbBiO_3$ was formed when a mixture of Tb_4O_7 and Bi_2O_3 was heated to 730 to 750°C, crystallizing in the cubic system with the lattice parameter a = 5.458 Å. Density at 25°C = 8.45 g/cm^2 (in toluene), or 8.49 g/cm^2 by x-ray methods. The refractive index was 1.830. Infrared spectra of $TbBiO_3$ contained a wide absorption band with a maximum at 485 cm^{-1}. (tr-auth)

13145 ESR OF Gd^{3+} IN MONOCLINIC ZIRCONIA. Escribe, C. (Univ., Toulouse); Dumais, J. C.; Gaite, J. M. Phys. Status Solidi (b); 57: No. 2, K135-K137(1973).

Measurements were carried out using a Q-band spectrometer with a TE_{102} cavity. For any sample orientation, 14 lines were observed; their position depends on the orientation in the dc field. When the orientation is parallel or perpendicular to the binary b axis, a 7-line pattern is recorded, as the two possible substitutional Zr^{4+} sites are magnetically equivalent. It is concluded that there is only one type of defect. The g-factor and spin Hamiltonian constants of Gd^{3+} in monoclinic ZrO_2 are tabulated. (DLC)

13146 EXCHANGE NARROWING IN ESR SPECTRA OF METALLIC $Gd_xLa_{1-x}B_6$ (x = 1 TO 0.01). Sperlich, G.; Janneck, K. H.; Buschow, K. H. J. (Technische Hochshule, Darmstadt, Ger.). Phys. Status Solidi (b); 57: No. 2, 701-706(1973).

Linewidth measurements are reported to the ESR spectra of metallic $Gd_xLa_{1-x}B_6$ compounds (x = 1.0 to 0.01). This system is remarkable because contributions from the exchange-narrowed linewidth ΔH_{ex} and the homogeneous linewidth ΔH_{hom} can be estimated. The interpretation of ΔH_{ex} leads to values for the "exchange fields" H_e as a function of the Gd concentration. (auth)

13147 PRODUCTION OF p–n JUNCTIONS IN SILICON CARBIDE BY BOMBARDMENT WITH LITHIUM IONS. Mirsagatov, Sh. A.; Morozkin, V. V ; Rubinov, V. M.; Chirva, V. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 37-40(1973). (In Russian).

Electron–hole transitions were produced in α–SiC crystals by implanting 30-keV Li ions to a depth of 0.5 to 0.6 μ. A study of the resulting volt–ampere characteristics of the crystals showed that the rectifying effect practically disappeared, in spite of the donor properties of the Li atoms. Annealing of the bombarded SiC at temperatures as high as 800°C tended to restore the rectifying ability. The possibility of obtaining sharp p–n junctions by Li-ion bombardment with subsequent annealing was demonstrated. (KSW)

13148 HELIUM IMPLANTATION EFFECTS IN PALLADIUM AT HIGH DOSES. Thomas, G. J. (Sandia Labs., Albuquerque, NM); Bauer, W. Radiat. Eff.; 17: No. 3-4, 221-234(1973).

Helium release, bubble and blister formation effects on the surface and in the bulk of high-dose helium-implanted palladium were studied using helium mass spectrometry, scanning electron microscopy, transmission electron microscopy, and x-ray diffraction. The dependence of these effects on implantation dose up to 2×10^{18} He atoms/cm^2, implantation temperature (–180 to +200°C) and limited pre-treatment was investigated. A strongly dose-dependent low-temperature (–180°C to 200°C) fractional helium release and accompanying surface deformation was found at high doses, and a qualitative model for these low temperature results is presented. (auth)

13149 STUDY OF THE NATURAL α-RECOIL DAMAGE IN ZIRCON BY INFRARED SPECTRA. Wasilewski, P. J. (Geological Survey, Washington, DC); Senftle, F. E.; Vaz, J. E.; Thorpe, A. N.; Alexander, C. C. Radiat. Eff.; 17: No. 3-4, 191-199(1973).

Natural α-recoil damage of 30 natural zircon specimens from Ceylon were examined by studying the infrared absorption spectra from 1 to 15 m. Two synthetic zircon specimens were also studied as undamaged reference specimens. The infrared absorption coefficient at 6 m (1666 cm^{-1}) was found to be a function of radia-

tion damage. The infrared data can be explained by a dual damage mechanism. The initial damage process produces degradation of the ν_3 vibrational mode in the infrared spectra which can be explained by deformation of SiO_4 tetrahedra, whereas the predominant effect of the advanced stage of radiation damage is the breakdown of the zircon lattice into SiO_2 and ZrO_2 which causes a skewing of the ν_3 absorption band. These data substantiate the model of Pellas and clarify the dualistic nature of the radiation damage mechanism. (auth)

13150 (ORNL-tr-2664) EQUILIBRIUM PRESSURE OF CARBON MONOXIDE OVER NIOBIUM-OXYGEN-CARBON SOLID SOLUTIONS. Fromm, E.; Spaeth, G. Translated by R. G. Mansfield from Z. Metallk.; 59: No. 1, 65-68(1968). 13p. Dep. NTIS $3.00.

The dependence of the CO equilibrium pressure over niobium on temperature and on the content of dissolved oxygen and carbon was determined between 1600 and 1900°C. The enthalpy of solution of carbon monoxide in niobium is -67 kcal/mole CO. The experimentally observed CO equilibrium pressures follow the relation $p_{CO} \sim C_{CO}^{1.6}$, and hence do not conform exactly to the Sieverts $\sqrt{p}$ law. In the temperature range of the experiments, the terminal solubility of the Nb-C-O solid solution with the C/O ratio 1 lies between 0.2 and 0.7 mole % CO. At temperatures above 1900°C, the equilibrium is disturbed by the evaporation of volatile oxides. (5 figures, 19 references) (auth)

13151 CONDITIONS OF PREPARATION OF TITANIUM AND NIOBIUM NITRIDES BY REDUCTION OF THEIR OXIDES WITH CARBON IN PRESENCE OF NITROGEN. Samsonov, G. V.; Polishchuk, V. S. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 1, 171-173(Jan 1973).

Translated from Zh. Prikl. Khim.; 46: No. 1, 174-176(Jan 1973).

It was found that in development of this method, which includes simultaneous nitridation in order to produce nitrides with minimal contamination by carbon, the process should be conducted at the lowest possible temperatures under nitrogen pressures above atmospheric. (auth)

13152 MATERIALS FOR QUICKER DECOMPOSITION OF AMALGAMS OF ALKALI METALS. I. Chemical Stability of Titanium, Vanadium, Chromium, and Tungsten Carbides and Titanium Boride in NaOH Solutions. Paseka, I.; Balej, J. (Inst. of Inorganic Chemistry, Prague). Chem. Prumysl; 23: No. 5, 235-238(May 1973). (In Slovak).

The chemical stability of titanium, vanadium, chromium, and tungsten carbides as well as titanium boride in 5 and 50% NaOH solutions was tested at 83°C both in the presence and absence of air. Titanium carbide proved to be the most stable of the tested materials under the given conditions: it practically does not dissolve in 5% NaOH and its corrosion in a 50% NaOH solution is very small. Titanium boride, which is decomposed in a 50% NaOH solution under vigorous evolution of hydrogen, is the least stable material. The corrosion of vanadium and tungsten carbides is quite quick initially, but gradually decreases; the presence of oxygen accelerates the corrosion especially in the initial stages. A moderate corrosion of chrominum carbide in a 5% NaOH solution was observed (the initial rate of corrosion was the smallest); however, in 50% NaOH, the corrosion of this material is considerable. It follows from the data that titanium carbide can be considered as a potentially more active material for a quicker decomposition of amalgams of alkali metals. (auth)

13153 ENERGY BANDS IN RUTILE STRUCTURE: WITH AN APPLICATION TO VO_2. Zhang, H. I.; Zhang, H. J. M. J. Korean Phys. Soc.; 5: No. 2, 57-62(Sep 1972).

A simple model band calculation was performed for rutile structure material, in particular for VO_2, using the tight-binding interpolation scheme. Nearest-neighbor interaction was assumed. The resulting energy bands and Fermi-surface are presented. (auth)

13154 INVESTIGATIONS ON Ta_2N-OXIDE FILMS. Juergens, W. (Siemens Aktiengesellschaft, Munich). Thin Solid Films; 16: No. 3, 359-367(Jun 1973). (In German).

Reactively sputtered Ta_2N films were oxidized anodically and basic data were measured. The density of the Ta_2O_5N turned out to be 6.1 g/cm³. A Ta_2N thickness anodization voltage ratio of 0.43 nm/V was determined which corresponds to an oxide build-up of 1.40 nm/V. From the measured anodization rate, i.e., the rise in voltage per unit of time at constant current, of 0.54 V/s (j = 1 mA/cm²) and stoichiometric considerations, it is concluded that the nitrogen is not bonded chemically in Ta_2N and Ta_2O_5N. (auth)

13155 ROLE OF DIMENSIONAL EFFECTS ON PHASE TRANSITIONS IN THIN FILMS. Gladkich, N. T. (Gorky State Univ., USSR). Thin Solid Films; 16: No. 3, 257-267(Jun 1973). (In German).

Some factors influencing phase transitions in thin films deposited by vacuum evaporation are discussed, particularly the role of size effect in phase transitions. The existence of a minimum total surface energy requirement is shown to lead to the formation of phases in thin films which are unstable in bulk samples, subsequent transitions to phases of higher symmetry being observed with decreasing thickness together with aggregated films consisting of discrete particles. In the limiting case of small dimensions, the condition for the minimum total surface energy requires fcc lattice phases and at high and low temperatures, liquid and amorphous phases, respectively, are formed. Materials for which data are presented include WO_3 and MoO_2. (7 figures, 24 references) (auth)

13156 METHOD OF DEVELOPING BORIDE PHASES BY COLOR METALLOGRAPHY. Butneva, N. I.; Faivilevich, G. A. Ind. Lab. (USSR) (Engl. Transl.); 38: No. 9, 1397-1398(Sep 1972).

Translated from Zavod. Lab.; 38: No. 9, 1111-1112(Sep 1972).

Ni-base alloys, containing various amounts of Cr, W, Mo, Ti, Nb, and Al, were treated with 0.03 and 0.4 wt % B. After isolation of the phases, color staining of the boride phases was performed using alkaline ferricyanide, sodium picrate, and thermal etching. Optimum conditions for differentiation of borides were determined. Cr_2B, Mo_2B, MoB_2, NbB_2, TiB, TiB_2, NiB, Ni_3B, M_3B_2, M_5B_4, Cr_5B3, and $M_{23}C_6$-type carbonitrides could be distinguished. (DLC)

13157 REACTIVELY EVAPORATED FILMS OF SCANDIA AND YTTRIA. Heitmann, W. (Fernmeldetechnisches Zentralamt der Deutschen Bundespost, Forschungsinstitut, 61 Darmstadt, Postfach 800, Germany). Appl. Opt. 12: No. 2, 394-397 (Feb 1973).

Sc_2O_3 and Y_2O_3 films were prepared by evaporation from resistance heated boats in a residual gas atmosphere of oxygen. Films of much lower absorptance were obtained than from coatings produced in high vacuum. The short wavelength limit of high transparency was between 300 nm and 400 nm, while the long wavelength absorption edge was reached at about 11 μm. Refractive indices of 1.8-2.0 were measured for both oxides. The influence of annealing on the optical properties of the films was investigated. The films were amorphous and proved to be mechanically very stable and water resistant. Electron micrographs showed smooth and uniform surfaces. By antireflection coatings of yttria the transmittance of silicon was increased from 52% to 99.4% at the maximum. Possible advantages by the application of Sc_2O_3 and Y_2O_3 instead of SiO for antireflection coatings on GaAs laser surfaces are discussed. (auth)

13158 FORMATION AND SURFACE CHARACTERISTICS OF HYDROUS METAL OXIDE SOLS. Matijevic, E.; Bell, A.; Brace, R.; McFadyen, P. (Clarkson Coll. of Tech., Potsdam, NY). J. Electrochem. Soc.; 120: No. 7, 893-899(Jul 1973).

Methods for preparation of chromium(III), aluminum, and zirconium(IV) hydrous oxide sols consisting of spherical particles, and of copper(I) oxide sols of cubic particles, are described. Under certain experimental conditions the particle size distribution is very narrow. Various properties of these sols are described and the mechanism of their formation and particle growth discussed. (10 figures, 19 references) (auth)

13159 HIGH-TEMPERATURE THERMODYNAMIC STABILITY OF DITANTALUM CARBIDE (Ta_2C). Kulkarni, A. D.; Worrell, W. L. (Univ. of Pennsylvania, Philadelphia). Met. Trans.; 4: No. 4, 931-933(Apr 1973).

The CO(g) pressure in equilibrium with a $Ta_2C-Ta_2O_5-Ta$ mixture was measured at temperatures between 1740 and 1900°K using the torsion-effusion technique. From the equilibrium data, the following equation for ΔG_f^0 of Ta_2C has been obtained: ΔG_f^0 (±300) = -47,000 (±2200) + 2.1 T. From the enthalpy term in the ΔG_f^0 equation, a value of -47.9 (±2.3) kcal/mole was calculated for ΔH_{298}^0 of Ta_2C which is in good agreement with several calorimetric results. (auth)

13160 TRANSVERSE CREEP AND STRESS-RUPTURE OF BORSIC-ALUMINUM COMPOSITES AND BORSIC-ALUMINUM COMPOSITES CONTAINING STAINLESS STEEL AND TITANIUM. Breinan, E. M.; Kreider, K. G. (United Aircraft Research Labs., Hartford). Met. Trans.; 4: No. 4, 1155-1165(Apr 1973).

The transverse creep and stress rupture behavior of a number of Borsic-aluminum composites was investigated at temperatures from 200 to 400°C. The composites studied consisted of nominally 50 vol % Borsic fiber and included matrices of 6061, 2024, 2219, and 5052 aluminum alloys. The effect of heat treatment was studied in the heat-treatable alloys. Where transverse composite behavior differed from matrix alloy behavior, the difference was found to be due primarily to a change in fracture mode at higher matrix strength levels from matrix failure to one which involves longitudinal fiber splitting. Of the four basic matrix alloys tested, the best creep resistance was obtained with the 2024 matrix. Additional improvement of transverse creep and stress rupture resistance was realized by incorporating transverse reinforcements such as SAP alloy foil, titanium alloy

foil, and 0.002 in. stainless steel wire in the composites. These reinforcements made possible good transverse properties at 400°C with density increases of ≤15%. The two best additions were 21% β III titanium foil and 6% AFC-77 stainless steel wire. A transverse fracture mode incorporating longitudinal fiber splitting was documented and characterized, and its effect on composite behavior determined. The use of nonsplitting fibers such as 5.6 mil B and 5.7 mil Borsic in preventing this fracture mode was investigated. (auth)

13161 COMPARATIVE STUDY OF ELECTRICAL PROPERTIES OF EuB_6 AND YbB_6. Mercurio, J. P.; Etourneau, J.; Naslin, R.; Hagenmuller, P. (Univ., Bordeaux). Mater. Res. Bull.; 8: No. 7, 837-844(Jul 1973). (In French).

Electrical conductivity and Seebeck coefficient of semiconducting EuB_6 and YbB_6 were investigated and compared. Results are discussed in terms of a band model in which the conduction band is the 5d or 6s band of the rare-earth sublattice. (auth)

13162 INTERFACE REACTIONS OF B_2O_3–Si SYSTEM AND BORON DIFFUSION INTO SILICON. Arai, E.; Nakamura, H.; Terunuma, Y. (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Electrochem. Soc.; 120: No. 7, 980-987(Jul 1973).

The interface reactions of the B_2O_3–Si system were studied by infrared spectroscopy, electron and x-ray diffraction, etc. The compound, produced at the B_2O_3–Si interface in the temperature range of 900 to 1200°C, closely resembled SiB_4 or SiB_6 in the diffraction measurements. The growth rate of silicon oxide, produced in the interface in an oxygen atmosphere, was several times as fast as that in a nitrogen atmosphere. These growth rates are much faster than the ordinary growth rate of silicon oxide in a dry oxygen atmosphere. From these data, the rate constants of growth of silicon oxide were estimated, assuming the relationship of the parabolic oxidation. Comparing these results with the doping amount of boron in silicon, it was confirmed that the rate-determining step of the transfer of boron into silicon was classified by whether the above Si–B compound was present or not. 10 figures. (auth)

13163 SELECTED PROPERTIES OF PYROLYTIC Ta_2O_5 FILMS. Knausenberger, W. H. (Bell Telephone Labs., Inc.; Whippany, NJ); Tauber, R. N. J. Electrochem. Soc.; 120: No. 7, 927-931(Jul 1973).

Pyrolytic Ta_2O_5 films, in thicknesses up to 30,000 Å, were produced by the $TaCl_5-CO_2-H_2$ reaction at 900°C. These films were characterized by use of transmission electron microscopy, electron microprobe analysis, and measurement of dielectric and optical properties. It was found that the films were orthorhombic Ta_2O_5 (β-Ta_2O_5) with a fine-grained structure. The films did not etch appreciably in hydrofluoric acid. Ellipsometric measurements indicated that the films had an index of refraction of 2.20 ± 0.03 at 5461 Å. In addition, certain areas of the films exhibited slight optical absorption. The optical energy gap was found to be 4.20 eV. The dielectric constant and the loss tangent of the pyrolytic Ta_2O_5 films were measured over the temperature range 78 to 488°K and the frequency interval 1 to 100 kHz and exhibited a surprisingly strong temperature dependence. These results and the electron microprobe results indicate the films are not stoichiometric. (8 figures, 4 tables, 23 references) (auth)

13164 ELLIPSOMETRIC STUDY OF THE FORMATION OF THIN OXIDE FILMS AT THE SURFACE OF SINGLE AND POLYCRYSTAL NIOBIUM. Dalirard, G.; Bardolle, J. (Centre National de la Recherche Scientifique, Orleans-la Source, France). Compt. Rend., Ser. C; 276: No. 10, 831-834(5 Mar 1973). (In French).

Ellipsometry was used to study the growth of thin oxide films at the surface of single-crystal and polycrystal niobium. The apparatus used is described. This apparatus enables samples to be examined in ultravacuum and the reaction to be studied at the temperature and pressure chosen. It was found that the surface film at pressure of 75 torr and a temperature between 300 and 350°C developed in a parabolic manner, both for polycrystalline samples and single crystals in the (110) and (100) planes. The activation energy of the (110) face is of the order of 50 kcal · $mole^{-1}$. (FR)

13165 REACTION OF ZIRCONIUM DIOXIDE WITH CARBON IN A VACUUM. Vlasov, V. G.; Revebtsov, V. V.; Beketov, A. R.; Kiselev, V. A. pp 135-138 of Termodinamika i Kinetika Protsessov Vosstanovleniya Metallov. Chizhikov, D. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The ZrO_2–C reaction kinetics were studied at 1650 to 2040°K, obtaining an apparent activation energy of 235 to 250 kilojoules/mole. The role of volatilization of the ZrO_2 during reduction is elucidated, and various mechanisms of the reduction process at elevated temperatures are examined. Intermediate reduction products ZrC_xO_y, $ZrC_{0.56}$, and $ZrC_{0.82}$ are discussed. (KSW)

13166 GRAPHITE AS A MATERIAL FOR A HEAT EXCHANGE FOR A HOT GAS. Nixdrof, J.; Janes, S. (to Battelle Institut eV). German Patent 1,751,207. 27 May 1971. Filed date 20 Apr 1968. (In German).

The use is described of graphite with a gas-tight and oxidation-resistant casing made up of borocarbides, silicides, or oxides of silicon, titanium, zirconium, tungsten, molybdenum, or aluminum as construction materials for pipes and plates for heat exchangers for hot gases. (TSS)

13167 ELECTRON TRANSFER SPECTRA OF SOME TETRAVALENT LANTHANIDE IONS IN ZrO_2. Vugt, N. V.; Wigmans, T.; Blasse, G. (Univ., Utrecht). J. Inorg. Nucl. Chem.; 35: No. 7, 2601-2602(Jul 1973).

A previous publication (Jorgensen et al., Mat. Fys. Medd. Dan. Vid. Selsk.; 35 : 15 : 1(1967)) described the diffuse reflection spectra of Pr^{4+} and Tb^{4+} in ThO_2 and Y_2O_3. Broad absorption bands in the region 20 to 30 kK were ascribed to electron transfer bands of the tetravalent lanthanide ions. A report is now presented on the spectra of ZrO_2 doped with Ce^{4+}, Pr^{4+} and Tb^{4+}. A broad and strong absorption band is found; its maximum is at 28.6 kK for $Zr_{0.99}Tb_{0.01}O_2$, 31.2 kK for $Zr_{0.99}Pr_{0.01}O_2$, and about 36 kK for $Zr_{0.99}Ce_{0.01}O_2$. The bands are ascribed to electron transfer from the O^{2-} ions to Tb^{4+}, Pr^{4+} and Ce^{4+}. (UK)

Metals and Alloys

13168 (EUR-4820(Vol. 6)(Pt. L)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20–24 SEPTEMBER 1971. Vol. 6. Structural Analysis and Design. Part L. Thermal and Mechanical Analysis. Jaeger, T. A. (Comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 653p. (CONF-710903–(Vol. 6)(Pt. L)). Eur.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

A separate abstract was prepared for each of 32 of the 34 papers of this volume. Two abstracts previously appeared in NSA: see NSA 25:60115 and 26: 27401. (LMT)

For abstracts of individual papers see: 12808, 13110–13115, 13243–13252, 13316, 13363, 14391, 14413, 14414, 14472, 14797–14804, and 14826.

13169 NEUTRON MAGNETIC FORM FACTOR OF GADOLINIUM. Freeman, A. J. (Northwestern Univ., Evanston, IL); Desclaux, J. P. Int. J. Magn.; 3: No. 4, 311-317(Dec 1972).

Recent neutron magnetic scattering experiments by Moon, Koehler, Cable, and Child (Phys. Rev.; B5: 997(1972)) have determined accurate magnetic form factors for Gd metal and paramagnetic Gd_2O_3. The 4f radial density in the metal was found to be significantly expanded relative to the nonrelativistic Freeman–Watson Hartree–Fock (H–F) wave function for the free Gd^{3+} ion; by contrast, the oxide form factor gave excellent agreement with the free ion predictions (except at very small scattering angles). Fully relativistic single and mixed-configuration solutions of the Dirac–Fock equations for the Gd^{3+} ion and for the neutral Gd atom were obtained. The relativistic contraction of the core electrons causes the 4f radial density to expand relative to the nonrelativistic H–F result and to yield a form factor in excellent agreement with the "local" form factor found for the metal. The atomic 5d contribution appears to account for the bulk of the diffuse (conduction electron) magnetization density, but substantial differences remain. The oxide form factor is interpreted to indicate an apparent contraction of the 4f density arising from covalent bonding. (auth)

13170 MATERIALES NUCLEARES. Tomo I. (Nuclear Materials. Volume I). Lopez Rodriguez, M.; Pascual Martinez, F. Madrid; Junta de Energia Nuclear (1971). 616p.

Nuclear materials are discussed in thirteen chapters that include: Reactor Materials; Properties of Metals; Equilibrium Diagrams and Metallurgical Treatment; Creep and Thermal Stresses; Metal Corrosion; Radiation Effects; Selection of Materials for Reactors; Uranium: Concentrate Production and Extractive Metallurgy; Production of Enriched Uranium; Uranium: Properties and Physical Metallurgy; Plutonium; Thorium; and Ceramic-type Fuels. (JCW)

13171 ELIMINATION OF SUSCEPTIBILITY TO HOT-CRACKING IN HIGHLY CORROSION RESISTANT NICKEL–MOLYBDENUM ALLOY, NiMo 30 (REMANIT HB). Hoffmann, B.; Oppenheim, R. Dew Tech. Ber.; 12: No. 1, 8-12(Feb 1972). (In German).

This alloy having high Mo content (nearly 30%), has very high resistance to corrosion in nonoxidizing conditions, even at elevated temperatures and also has good strength at elevated temperatures.

It finds effective use in situations in which the corrosion resistance of high-alloy austenitic steels is not adequate. Difficulties in cold working, final heat treatment, and welding are described. A table indicates the limits of contents of the constituents of the conventional alloy and those for the improved alloy in modern production. Content limits for the improved alloy have higher Si, Mn, and Fe than for the conventional alloy and provide for small additions of V and B. Results of mechanical tests (tensile and bend) at room and elevated temperatures on the conventional and improved alloys are given and these show freedom of the latter from low ductility at high temperatures. (Metals Abstr.)

13172 TERMODINAMIKA I KINETIKA PROTSESSOV VOSSTANOVLENIYA METALLOV. (Thermodynamics and Kinetics of Reduction Processes for Metals). Chizhikov, D. M. Moscow; Izdatel'stvo Nauka (1972). 184p.

This publication consists of 57 separate papers by various authors that were delivered at the Conference on Thermodynamics and Kinetics of Reduction Processes of Metals, May 20–23, 1969, at the Institute of Metallurgy, Moscow. The thermodynamics, mechanisms, catalytic and contact phenomena, kinetic features, and metallurgical aspects of many reactions are considered. Rare metals and refractory metals are the subjects of a number of papers in addition to those on Cu, Fe, Zn, Ag, and Pb. Reducing agents studied included natural gas, CH_4, CO, C, H_2, and mixtures of some of these with H_2O and CO_2. Five papers related to the reduction of oxides of U, W, Mo, Zr, and Re, and are abstracted separately. (KSW)

For abstracts of individual chapters see: 13165, and 13222–13225.

Corrosion and Erosion

13173 (BMI-X-10260) ELECTROCHEMICAL STUDY OF THE CORROSION OF HIGH-STRENGTH ALLOYS IN CONTACT WITH ZIRCALOY-4 (LWBR DEVELOPMENT PROGRAM). Haynie, F. H.; Berry, W. E.; Boyd, W. K. (Battelle Memorial Inst., Columbus, Ohio). May 1973. Contract W-7405-eng-92. 22p. Dep. NTIS $3.25.

For Bettis Atomic Power Lab., Pittsburgh.

Potential difference and current flow between galvanic couples were studied in pH 10 (NH_4OH) water at 650°F containing 25 to 50 cm^3 hydrogen per kg and <0.1 ppM oxygen. Film-free and prefilmed Zircaloy-4 was found to be anodic to Inconel 718, Hastelloy N, and PH 14-8Mo stainless steel, prefilmed Zircaloy-4 was anodic to Inconel 625, and prefilmed Zircaloy-4 with and without a coating of Neolube lubricant was anodic to AM-350; but film-free Zircaloy-4 with and without Neolube coating was cathodic to AM-350. The galvanic coupling of the dissimilar metals to Zircaloy-4 did not adversely affect the corrosion rate of Zircaloy-4 as indicated by the excellent duplication of results for coupled specimens with published results for uncoupled material. The coupling of AM-350 containing transformed martensite to AM-350 containing retained austenite did not produce measurable galvanic effects. The linear polarization method of determining corrosion rates could not be applied under these conditions because of the very small corrosion currents and the presence of redox reactions. (auth)

13174 (BMI-X-10286) EFFECTS OF GALVANIC CORROSION AND HYDROGEN ON AM-350 AND INCONEL 718 MATERIALS. LWBR Development Program. Moreland, P. J.; Berry, W. E.; Stiegelmeyer, W. N.; Boyd, W. K. (Battelle Columbus Labs., Ohio). May 1973. Contract W-7405-eng-92. 56p. Dep. NTIS $5.00.

For Bettis Atomic Power Lab., Pittsburgh.

Critical experiments were conducted to determine whether hydrogen produced by local-cell corrosion or galvanic coupling in ambient or high-temperature water can cause cracking of two strained LWBR fuel-rod support-grid materials, AM-350 and Inconel 718. Studies with AM-350 involved galvanic-couple tests with Zircaloy-4 in the strained and unstrained condition in 650°F pH 10 water; cathodic charging in primary water to simulate more aggressive conditions than those that would be encountered in service (higher hydrogen flux and lower temperatures); determination of hydrogen permeation and diffusion rates at temperatures of 100 and 200°F; and location of the absorbed hydrogen in the alloy. Studies with Inconel 718 involved severe cathodic charging at 10 mA per $in.^2$ in 5 wt % H_2SO_4 containing As_2O_3 at room temperature. The results revealed that galvanic coupling had no effect on the corrosion rate or hydrogen uptake in either member of the galvanic couple and did not cause cracking of strained specimens in the 4-week exposures at 650°F. No appreciable quantity of the hydrogen that was absorbed in AM-350 in 650°F water was lost as the result of exposing the specimens for 168 h to ambient conditions in the laboratory. The studies at the lower temperatures with AM-350 revealed that the hydrogen was associated with the austenite phase in the microstructure, that the hydrogen permeation rate and diffusion constant were dependent on surface films, and that cathodic charging in room-temperature primary water at a current density of 0.039 mA per cm^2 saturated the specimens with hydrogen within 1000 h but did not produce cracking in strained prefilmed specimens. Extrapolation of these results to high-temperature primary water indicated that cracking would not occur in strained AM-350 at hydrogen fluxes corresponding to corrosion rates 100 times those normally expected of AM-350 in reactor service. The strained Inconel 718 did not crack when cathodically charged in sulfuric acid at current densities that were orders of magnitude greater than those that may be encountered in reactor service. (auth)

13175 (COO-841-29) THERMOTRANSPORT STUDIES IN LIQUID ALKALI METAL ALLOYS. Murarka, S. P.; Kim, T. Y.; Hsieh, M. Y.; Swalin, R. A. (Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science). 1973. 18p. Dep. NTIS $3.00.

Thermotransport was studied as a function of composition in the Na–K liquid alloy system. Thermotransport of trace concentration of Rb in K, Rb in Na, and Na in Rb were also investigated. A reversal in direction of specie migration occurred at an intermediate composition in the Na–K system. In K-rich alloys Na, for example, migrated toward the hot end of the capillary whereas, in Na-rich alloys, Na migrated to the cold end. At some intermediate composition (between 64.6 at. % Na and 76.6 at. % Na) a crossover occurred and consequently no thermotransport occurred at that composition. Results compare with results of electromigration studies by other investigators, which indicate that a sign reversal in direction of electromigration occurs in both the Na–K and Na–Rb systems. Theoretical calculations of the heats of transport in the alloy systems studied yield quite good agreement with the observed sign of the heat of transport for most of the alloys investigated. (auth)

13176 (LA-5169) COMPATIBILITY OF ZIRCALOY-4 AND Nb–1 WT% Zr ALLOY IN HYDROGEN AS A FUNCTION OF TEMPERATURE. Riley, R. E.; Jones, T. I. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 20p. Dep. NTIS $4.00.

The susceptibility of zirconium- and niobium-base alloys to hydrogen embrittlement is well known. However, little is known about the compatibility of these materials when exposed to a hydrogen atmosphere at moderately elevated temperatures. Evidence that Zircaloy-4 and Nb–1 wt % Zr alloys exhibit a reasonable time–temperature–hydrogen compatibility range before catastrophic embrittlement occurs is presented. (auth)

13177 (LA-UR-73-764) MATERIALS COMPATIBILITY PROBLEM IN SNAP FUEL CAPSULES. Mulford, R. N. R.; Bronisz, S. E. (Los Alamos Scientific Lab., N. Mex.). [nd]. 11p. (CONF-730801-2). Dep. NTIS $3.00.

From symposium on materials performance in operating nuclear systems; Ames, Iowa, USA (28 Aug 1973).

The tantalum based alloys used for fuel capsules in some types of radioisotopic thermoelectric generators (RTG's) were chosen originally because of their superior strength properties at elevated temperatures. However, basic incompatibility between the $^{238}PuO_2$ fuel and the tantalum alloys was predicted from thermodynamic considerations. Oxygen transfer from fuel to container leads to severe embrittlement and consequent impairment of the container. The incompatibility was demonstrated both in laboratory experiments and in prototype RTG's. The scheme used to solve this problem and determine conditions under which Ta alloys are stable in the desired application are described and discussed. (auth)

13178 (ORNL-TM-4188) EFFECT OF FeF_2 ADDITION ON MASS TRANSFER IN A HASTELLOY N: LiF–BeF_2–UF_4 THERMAL CONVECTION LOOP SYSTEM. Koger, J. W. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 23p. Dep. NTIS $3.25.

The compatibility of Hastelloy N with high-purity LiF–BeF_2–UF_4 (65.5–34.0–0.5 mole %) in a low-flow temperature-gradient system (maximum temperature 704°C, minimum temperature 538°C) was shown to be quite good. (The maximum corrosion rate was 0.04 mil/year over 29,500 h of operation.) Subsequent experimental additions of FeF_2 increased the mass transfer of the system; specifically, the maximum weight loss rate before FeF_2 additions was 1×10^{-4} mg cm^{-2} h^{-1}, while after addition the rate was 6×10^{-3} mg cm^{-2} h^{-1}. Cracks which transformed into voids were found in the specimens after exposure to the salt containing FeF_2. (auth)

13179 CARBURIZATION–DECARBURIZATION BEHAVIOR OF STAINLESS STEELS IN A SODIUM ENVIRONMENT. Snyder,

R. B.; Natesan, K.; Kassner, T. F. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 112-113(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13180 OXIDATION OF FERRONIOBIUM. Khrustalev, B. N.; Chistyakov, S. L.; Osenova, L. M. Izv. Akad. Nauk SSSR, Metal.; No. 2, 109-112(1973). (In Russian).

The atmospheric oxidation at 300 to 1100°C of two industrial ferroniobium alloys was studied: Nb-22.5% Fe-11.8% Si-3.5% Ti-1.2% Al and Nb-24.7% Fe-24.5% Mn-2.1% Al-1.2% Ti-1.1% Si, with traces of C, S, and P present. The phase compositions of the original alloys and their oxidation products were identified. The Nb-Fe-Mn alloys proved to be less susceptible to oxidation under these conditions. For minimizing Nb loss in the alloying of steel a low-temperature (200 to 300°C) roasting is recommended. (KSW)

13181 CORROSION RESISTANCE OF ALLOYS OF VANADIUM WITH NIOBIUM IN 3% NaCl SOLUTION. Migai, L. L.; Arons, V. L; Mal'chevskii, E. G.; Vorob'eva, L. P.; Druzhinina, I. P. (State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 8: No. 5, 500-501(1972).

Translated from Zashch. Metal.; 8: No. 5, 558-560(1972).

Sheets of V-Nb alloys containing 0, 10, 20, 33, 45, 60, and 100% Nb were investigated. Mechanical properties were measured in the annealed and deformed (85 and 98%) states. Strength was increased by Nb additions. The corrosion rate in aerated 3% NaCl solutions of varying pH was reduced by Nb additions up to 20% Nb; thereafter, Nb had no effect. Potentiostatic polarization curves are given. (DLC)

13182 REACTION OF A Ni-Cr-Si-B COATING WITH 1Kh18N9T STEEL DURING PROLONGED ANNEALING IN RANGE 700 TO 900°C. Antonova, E. A.; Andrushchenko, N. S.; Sinai, L. M. (Inst. of Silicate Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 8: No. 5, 481-485(1972).

Translated from Zashch. Metal.; 8: No. 5, 538-544(1972).

Results are presented of a quantitative electron-microprobe investigation into the diffusion of elements from a coating (70% Ni-20% Cr-5% Si-5%B) into steel and the reverse diffusion of iron from the base into the coating. Results show that the coating ruptures at high temperatures. (auth)

13183 COATING HIGH-STRENGTH STEELS WITH A CADMIUM-TIN ALLOY FROM A HYDROFLUOBORIC ELECTROLYTE. Livshits, A. B.; Loshkarev, Yu. M.; Fedash, V. P. (Dnepjropetrovsk State Univ., USSR). Prot. Metals (USSR) (Engl. Transl.); 8: No. 4, 386-390(1972).

Translated from Zashch. Metal.; 8: No. 3, 435-440(1972).

The effect of the basic components of the electrolyte and the conditions of electrolysis (Sn^{2+} and NH_4CNS concentrations, pH value, current density, etc.) on the simultaneous discharge of cadmium and tin ions from a hydrofluoboric solution containing joiner's glue and NH_4CNS is considered. On increasing the CNS^- concentration, the polarization associated with the electroreduction of the cadmium ions falls in a regular manner; this leads to the enrichment of the alloy with the electronegative component in the case of low and medium current densities. (auth)

13184 ELECTRO-ABRASIVE MACHINING OF METALS AND ALLOYS WHEN SURFACE OF ANODE IS CONTINUOUSLY RENEWED. Filimonenko, V. N.; Kreichman, B. M.; Dagaev, N. L. Elektron, Obrab. Mater.; No. 6, 16-19(1972). (In Russian).

A convenient method of studying the electrochemical behavior of metals and alloys under conditions of electro-abrasive machining is described together with the corresponding apparatus. As an example, the polarization characteristics of a WC-Co hard alloy subjected to this type of processing are presented. The polarization curves in the presence and absence of the continuous renewal of the anode surface have considerable qualitative differences. (Metals Abstr.)

13185 KORROZIYA I KORROZIONNOSTOIKIE SPLAVY. (Corrosion and Corrosion-Resistant Alloys). Tomashov, N. D.; Chernova, G. P. Moscow; Metallurgiya (1973). 232p.

The theory of corrosion processes, local corrosion (pitting, intercrystalline cracking), and corrosion with simultaneous mechanical stress (fissuring, fatigue, and cavitation) is examined. Metal alloys of high passivity and corrosion resistance of stainless steels of various compositions (including 3% Mo up to 20% Ta + Nb, and similar alloys) are discussed at length. (76 figures, 138 references) (KSW)

13186 APPLICATION OF NUCLEAR SPECTROMETRY METHODS TO ELECTROCHEMICAL AND CORROSION STUDIES. Dembrovskii, M. A. (Scientific Research Inst. for Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 8: No. 4, 347-358 (1972).

Translated from Zashch. Metal.; 8: No. 3, 387-402(1972).

The application of α-, β-, and γ-spectrometry to various electrochemical and corrosion studies (measurement of low corrosion rates of passive metals and alloys, determination of simultaneous adsorption of several elements, control of the electrochemical purification of metals, study of the anodic oxidation and migration of metal atoms and oxygen through anodic films, determination of water in passivating films, and so on) is reviewed. Numerous general problems which arise are discussed (method of introducing the radioisotopes, calculation of radiation effects, analysis of simple and complex γ spectra). (52 references) (auth)

13187 ELECTRODEPOSITION OF CERTAIN METALS FROM FLUOBORATE SOLUTIONS WITH ORGANIC ADDITIVES. Loshkarev, Yu. M.; Livshits, A. B.; Snetkova, L. P.; Malaya, R. V.; Gorlova, M. S. (Dnepropetrovsk State Univ., USSR). Prot. Metals (USSR) (Engl. Transl.); 8: No. 3, 248-252(1972).

Translated from Zashch. Metal.; 8: No. 3, 277-282(1972).

The adsorption and inhibiting action of organic additives in the electrodeposition of zinc, cadmium, and tin from fluoborate solutions was studied. It was shown that from sulfate to fluoborate electrolytes, the adsorption increases, and the inhibiting effect of additives in the region of a positive charge of the surface increases. New effective regulators of the growth of cathodic deposits of zinc, cadmium, and tin are proposed. (auth)

13188 EFFECT OF SOME ALLOYING ELEMENTS IN VANADIUM CORROSION OF HEAT-RESISTANT ALLOYS. Cihal, V. Strojirenstvi; 22: No. 5, 294-296(May 1972). (In Czech).

The combined effect of alloying additions of Me = Mo, W, Cu, Fe, and Cr and the presence of V in oil fuels on the corrosion resistance of binary Ni-Me alloys (mainly used in gas turbines) was studied. Plate samples were exposed for 2 to 4 h in crucibles to one of the following mixtures: V_2O_5, V_2O_5 + 30 wt % Na_2SO_4, Na_2SO_4 + 10 wt % NaCl at 600 to 900°C. Plots are presented for the dependence of corrosion losses on temperature, corrosion medium, and composition. Only Cr increased the corrosion resistance, especially at a content above 20%; all other metals decreased it. The Na_2SO_4 + NaCl mixture was aggressive only at temperatures above 800°C. 15 ref. (Metals Abstr.)

13189 STRESS-CORROSION CRACKING OF Ti-8Al-1Mo-1V IN AQUEOUS ENVIRONMENTS. II. Plastic Zones, Crack Morphology, and Fractography. Boyd, J. D. (Battelle Columbus Labs., OH). Met. Trans.; 4: No. 4, 1037-1045(Apr 1973).

Optical and electron metallographic studies of stress-corrosion cracks in Ti-8Al-1Mo-1V have verified that the principal crack extension mechanism is cleavage of the α grains. There are two distinct crack morphologies which correspond to the two regimes of subcritical crack velocity. At low stress intensities ($\dot{a} \propto K_I$) the microscopic crack front consists of small cleavage facets approximately 1 to 4 α grain diameters in size, and ligaments of material which fracture by ductile rupture and corrosion. At high stress intensities ($\dot{a} \simeq$ constant), the crack front consists of large cleavage "fingers", 20 to 50 α grain diameters in length, separated by regions which fracture by a combination of cleavage (on a much smaller scale), ductile rupture, and corrosion. The transition from Stage I to Stage II crack propagation apparently occurs when the strain-energy release rate is sufficient to support two crack branches, i.e., $K_I \geq \sqrt{2}\, K_{Iscc}$. Thereafter, the diameter of the plastic zone at the crack tip remains constant, suggesting that the effective stress intensity at the tip of each branch is also invariant. The slip within the plastic zone is markedly nonhomogeneous, and trenches are often observed along the slip steps. (auth)

13190 STRESS-CORROSION CRACKING OF Ti-8Al-1Mo-1V IN AQUEOUS ENVIRONMENTS. I. The Kinetics of Subcritical Crack Propagation. Boyd, J. D. (Battelle Columbus Labs., OH). Met. Trans.; 4: No. 4, 1029-1035(Apr 1973).

Precracked specimens of Ti-8Al-1Mo-1V were tested in salt water, and the subcritical crack velocity was measured as a function of applied stress intensity. The minimum applied stress intensity which produces subcritical cracking, K_{Iscc}, varies inversely with the average chloride-ion concentration of the environment, but K_{Iscc} does not vary significantly with temperature. Plots of subcritical crack velocity, $\dot{a}$, against applied stress intensity, K_I, reveal two types of cracking behavior. At low stress intensities $\dot{a}$ is approximately proportional to K_I (Stage I crack propagation). At high stress intensities, $\dot{a}$ is approximately constant, independent of K_I (Stage II crack propagation). The apparent activation energy for subcritical crack propagation is 5600 cal-(g-mole)$^{-1}$, and $\dot{a} \propto [Cl^-]^{\frac{1}{4}}$. It is suggested that the instantaneous subcritical crack velocity is limited by the rate of production or by the diffusion of some embrittling species. (auth)

13191 PROTECTIVE COATINGS ON METALS. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corporation (1972). 236p. $32.50.

Translation of Zashchitnye pokrytiya na metallakh. Translated by Z. S. Michalewicz.

Fifty-two articles are included in the volume. A separate abstract was prepared for each of twelve articles. The remaining articles were not in the scope of NSA. (JRD)

For abstracts of individual papers see: 13192–13198, and 13202–13206.

13192 SOME PROPERTIES OF BORON-CONTAINING DIFFUSION LAYERS. Zemskov, G. V.; Kogan, R. L.; Shevchenko, I. M. (Odessa Engineering Inst.). pp 44–48 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

A study was conducted on surface alloying of B with Al, B with Ti, and B with Si on C steel and on ZhS6-K Ni-base Cr–Al–Ti–W alloy for improved oxidation resistance at 1000 to 1200°C. The highest corrosion resistance is imparted to specimens by boroaluminizing treatment, as a result of which their surface remains clean and free from signs of reaction with the melt. No weight loss is observed. The microstructure of the boroaluminized coating had undergone no changes except for a 20-μ increase in the depth of the boride zone and a slight coarsening of the intermetallic grains in the outer zone of the layer. The test at 900°C was withstood only by the boroaluminized specimen, although this specimen too sustained some local surface damage due to attack by molten aluminum. These results show that boron-containing coatings, especially those produced by the boroaluminizing process, open up real possibilities in the field of protection of carbon steels. (JRD)

13193 NITRIDING KINETICS OF NIOBIUM. Samsonov, G. V.; Kaplina, G. S. (Inst. of Materials Science, Kiev). pp 71–75 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

A study was made of the reactive diffusion of nitrogen in niobium. By examining external symptoms of reactive diffusion, it was established that the process under investigation is one of nitrogen diffusion through reaction products. The kinetics of the nitriding process of niobium was also investigated. It was found that layer growth as a function of time obeys a parabolic law and is limited by the diffusion of nitrogen through reaction products. The phase composition of the resulting coating was determined. The coating consists of two phases, NbN and Nb_2N, under which there is a zone of an α solid solution of nitrogen in niobium. The diffusion parameters of nitrogen in NbN were calculated. (auth)

13194 SILICONIZING OF MOLYBDENUM IN SILICON CHLORIDES BY A CIRCULATION PROCESS. Arzamasov, B. N.; Glushchenko, V. N.; Bul, N. K.; Vinogradov, A. V. (Moscow Technical Coll.). pp 121–125 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

A thermodynamic analysis of Mo siliconizing reactions using a circulation process involving H-free gaseous silicon chloride mixtures was conducted. Results show that the optimum parameters for the siliconizing of molybdenum are a partial pressure of mixed silicon chlorides of 240 torr at the treatment temperature, a silicon temperature of 1200°C, and a specimen temperature of 1125°C. The processes in the reaction take place in two stages: initially, at high temperatures, silicon subchlorides are formed, and these subsequently react with molybdenum. (JRD)

13195 MULTICOMPONENT DIFFUSION IMPREGNATION FROM SUSPENSIONS. Zemskov, G. V.; Kogan, R. L.; Moroz, V. L; Kross, E. V. (Odessa Engineering Inst.). pp 145–148 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

Results of studies are presented on impregnation of ZhS6-K Ni–Cr alloy with Al, Si, B, Cr, and Zr using a slurry method involving application of the slurry on the ZhS6-K surface and annealing the specimen for 2 to 5 h at 700, 850, 950, 1050, 1100 and 1200°C. Results show that the structure, hardness, and alloying element content of two- and three-component coatings depend on the thickness of the applied slurry layer, the proportions of the impregnating elements in the slurry, and the diffusion annealing parameters. By varying these factors, it was possible to discover the optimum process conditions resulting in the formation of satisfactory coatings of 50 to 100 μ depth. The slurry technique may be employed for producing on nickel–chromium alloys aluminum-base multicomponent diffusion coatings with additions of other alloying elements. (JRD)

13196 MULTICOMPONENT DIFFUSION IMPREGNATION OF IRON AND STEEL WITH BORON, SILICON, AND ALUMINUM. Kaidash, N. G.; Chastokolenko, P. P.; Tatarchuk, V. S.; Semeneko, I. A.; Pavlyukov, A. A.; Bovkun, G. A. (Umansk Pedagogical Inst., USSR). pp 149–155 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

A study was made of the boriding of iron and steel in a vacuum and in containers with liquid seals, using mixtures of boron carbide and borax. It was established that the optimum impregnating mixture composition and process parameters for boriding are as follows: 84% B_4C + 16% borax, t = 950 to 1000°C, and τ = 6 to 9 h. Some regularities of diffusion coating formation in boron–silicon and boron–aluminum impregnation were determined. The effects of the composition of the impregnating mixture on the thickness of diffusion coatings forming during the borosiliconizing and boroaluminizing of iron and steel were studied. The optimum process parameters were found to be: t = 1000°C and τ = 6 h for borosiliconizing and t = 1050°C and τ = 6 h for boroaluminizing. (auth)

13197 ELECTROLYTIC BOROCHROMIZING OF STEELS. Pasechnik, S. Ya.; Korotkov, V. D.; Lokatosh, O. V.; Afanas'ev, A. A.; Obednin, L. F.; Miroshnikova, Z. P. (Voronezh Technological Inst., USSR). pp 170–173 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

A study was made of simultaneous electrolytic impregnation of steel surfaces with B and Cr. On the basis of thermodynamic calculations, the compositions of effective borochromizing electrolytes were chosen. The following electrolyte compositions are recommended for borochromizing: 3 to 8% Cr_2O_3, 75 to 80% B_2O_3, and 22 to 12% NaF. It has been shown that, with rise in the chromic oxide content of the electrolyte, the layer microhardness and depth decrease. X-ray structural analysis revealed the existence in the diffusion layer of the following phases: $(Fe, Cr)_{23}C_6$, CrB_2, Cr_2B, Cr_5B_3, FeB, and Fe_2B. It has been established that the presence of chromium enhances the ductility of a diffusion layer. (JRD)

13198 DEPOSITION AND STRUCTURE OF SOME COMPOSITE ELECTROLYTIC COATINGS. Guslienko, Yu. A.; Epik, A. P. (Inst. of Materials Science, Kiev). pp 180–182 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

Development of procedures for electrodeposition of Fe–TiC and Ni–WC coatings on substrates is described. It was found that the inclusion of particles of a dispersed phase strongly affects the crystallization process of the metal being deposited, leads to higher stresses and greater defectiveness of structure, and, in the last analysis, increases the strength characteristics of the deposit matrix. In addition to the change in the character of deposit crystallite orientation, defective structures are found to form in the matrix material in the neighborhood of the dispersed phase particles. The addition of WC was found to produce an increase in the coercive force of nickel deposits, amounting to 8 to 9.2 kA/m depending on the powder concentration in the deposit. (JRD)

13199 HETERO-EPITAXIAL TANTALUM FILMS ON SAPPHIRE. O'Neal, J. E. (McDonnell Douglas Corp., St. Louis). Thin Films; 2: No. 2, 119-137(Aug 1972).

Tantalum thin films were deposited by electron beam evaporation in an ultrahigh vacuum onto (00.1) and (10.2) sapphire substrates. A correlation was made between the structure of the deposited tantalum films and (1) the substrate orientation, (2) the substrate temperature, and (3) the deposition rate. The substrate temperature was varied between 25° and 1000°C and deposition rates of 100 and 200 Å/min were used. Single-crystal tantalum films were formed on both substrate orientations over two different temperature ranges. (auth)

13200 INFLUENCE OF ALLOYING ON RESISTANCE OF REFRACTORY ALLOYS IN SODIUM. Vishkarev, O. M.; Zot'yev, Yu. A.; Karskii, N. V.; Levkopulo, I. A. Zashch. Metal.; 7: No. 5, 552-557(1971). (In Russian).

A study was made of the resistance in liquid Na heat-transfer agent of stainless austenitic steels and Ni-based alloys alloyed with Cr, Mo, W, Al, Si, Mn, Nb, Ti and Ce, the alloys having been melted in an open induction furnace. The tests were carried out in filtered Na in a forced circulation system, using cast specimens. It was found that the corrosion of alloys not containing components oxidizable in this medium was the higher the greater the total content of the easily soluble Ni and Cr. Alloys containing up to 3% Al and other elements susceptible to oxidation (Si, Zr, Ce) suffered intergranular corrosion, as a result of which a brittle, easily breakable phase was formed along grain boundaries. Intergranular corrosion was reduced by an increase in Cr content. The dissolution of alloys was markedly reduced by alloying with more than 3% Al, due to the formation of an oxide film. However, on these alloys a brittle internal oxidation layer was formed and split to produce pitting. The susceptibility of this layer to flaking rose with increase in the oxygen content of the Na, and fell on alloying with Cr. (Corros. Control Abstr.)

13201 FABRICATION OF RECTIFICATION COLUMN FROM Ni–Cr–Mo ALLOY EP567. Abelev, M. M.; Shvarts, G. L.; Gerasimenko, G. I.; Belinskii, A. L.; Besednii, V. A.; Kstyuchenko, V. A. Khim. Neft. Mashinostr.; No. 8, 24-26(1971). (In Russian).

Fabrication involved the use of metal from 74 melts, containing Cr 15.2 to 15.95%, Mo 15.3 to 16.1%, Si 0.06 to 0.15%, and Fe 0.1 to 0.35%. Statistical data from tests in a solution containing 30% H_2SO_4, 10% HNO_3 and 60% H_2O at 80°C over 96 h show that at a Si content not below 0.12% weld joints between alloy and basic metal are not susceptible to knife-line and intergranular corrosion after challenging heat treatment. Heating before hot pressing followed by slow cooling leads to the separation of NiMo, Ni_3Mo, and carbide phases and to the appearance of susceptibility to intergranular corrosion, which was eliminated by quenching after pressing. The corrosion resistance of welds was increased by cooling the reverse side of a weld using water–air or water, and by carefully cleaning oxides and oil from edges before welding. (Corros. Control Abstr.)

13202 STRUCTURE AND CHARACTERISTICS OF FORMATION OF THE TRANSITION ZONE IN THE BORIDING OF MEDIUM-CARBON ALLOY STEELS. Puchkov, E. P.; Lyakhovich, L. S.; Voroshnin, L. G. (Belorussian Engineering Inst., Minsk). pp 27-30 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

Results are presented of investigation into the effects of alloying elements on the depth of boron and carbon containing transition zones in alloy steel. It was found that titanium, molybdenum, chromium, and silicon decrease the rate of boron diffusion in austenite (0.4% C), thereby reducing the depth of the transition zone, the most effective in this respect being titanium and molybdenum. The effect of nickel on the rate of boron diffusion is negligible. All the alloying elements investigated hinder the redistribution of carbon in the course of formation of the boride layer. The order of the intensities of this influence is as follows: Ti, Mo, Cr, Ni, and Si. The intensity of the inhibiting effect on the rate of carbon diffusion in austenite decreases on passing from titanium to silicon. Titanium, molybdenum, and chromium largely neutralize the adverse effect of carbon and boron on the growth of austenitic grains in the transition zone. Nickel and silicon have practically no effect on this reaction. (JRD)

13203 RADIOACTIVE ISOTOPE STUDY OF CARBON REDISTRIBUTION IN THE BORIDED LAYER. Dukarevich, I. S.; Mozharov, M. V. (Malyshev Kharkov Factory). pp 31-33 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

The redistribution of C during the diffusion impregnation of steel with boron was studied by tracer technique using ^{14}C. It was found that during boriding, carbon, being insoluble in iron borides, is almost completely driven out of the boride zone toward the core. As a result of the inward migration of carbon atoms, the transition zone of the borided layer becomes carburized to a greater depth than that of the boride zone. (JRD)

13204 REDISTRIBUTION OF COMPONENTS IN Kh15N15 STEEL DURING BORON IMPREGNATION. Smirnov, V. P.; Bespalov, A. G.; Zolotukhin, B. N.; Pavlinov, L. V. (Moscow). pp 34-36 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

The redistribution of Fe, Cr, Ni, and C in Kh15N15-type Cr–Ni steel during boriding in Na medium was studied. Results show that boride coatings of good quality can be produced on Kh15N15-type steels in a sodium medium containing pure boron or boron carbide. The application of boride coatings is accompanied by a substantial redistribution of the steel components, including a relative decrease in the iron and nickel concentrations and an increase in the chromium and carbon concentrations at the steel/boride phase interface. The effect of temperature on the rate of growth of the boride phase may be represented by the equations $[(x^2/\tau) = 8.1 \cdot 10^{-5} \exp(-21{,}000/RT)\ cm^2/sec)]$ in the case of sodium containing pure boron, and $[(x^2/\tau) = 1.8 \cdot 10^{-5} \exp(-21{,}000/RT)\ cm^2/sec)]$ in the case of sodium containing boron carbide. (JRD)

13205 ELECTROLYTIC BORIDING AND BOROALUMINIZING OF CARBON STEELS. Pasechnik, S. Ya.; Korotkov, V. D.; Lokatosh, O. V.; Afanas'ev, A. A.; Obednin, L. F.; Ryazhskikh, K. B.; Khabarov, V. A.; Venevtsev, Yu. M. (Voronezh Technological Inst., USSR). pp 37-40 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

Results of experiments on electrolytic boriding and boroaluminizing carbon steels are presented, including studies concerning the effects of the principal electrolysis parameters (temperature, current density, time) on the depth of boroaluminized layers. Results show that the rate of impregnation is higher in boroaluminizing than in boriding, which is attributable to an increase in the diffusion coefficient of boron in the bcc (α) phase. The boroaluminized layer consists of iron borides and aluminum-containing phases ($FeAl_3$). The redistribution of carbon in steel under the action of boron, aluminum, and nickel is similar in character. The carbon redistribution in the substrate obeys a parabolic law. Boroaluminizing increases the wear resistance and reduces the coefficient of friction of steel–bronze friction pairs in an abrasive medium with a lubricant. Use of a reversing current in electrolytic impregnation raises the rate of chemicothermal treatment. The optimum anodic-to-cathodic period ratio, τ_a/τ_c, is 0.5 at a cathodic-to-anodic current density ratio of two. (JRD)

13206 EFFECT OF CHEMICAL COMPOSITION OF STEELS ON STRUCTURE OF DIFFUSION LAYERS AND FATIGUE STRENGTH AFTER DIFFUSION BORIDING. Karpenko, G. V.; Pokhmurskii, V. I.; Protsik, V. G.; Zamikhovskii, V. S. (Physicomechanical Inst., Lvov). pp 41-43 of Protective Coatings on Metals. Volume 4. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1972).

The study was conducted using samples of carbon steel and stainless steel. An improved fatigue limit in carbon steel was attributed to the presence of high residual compressive stresses and to a zone enriched by the C driven out of the surface layer. An increase in fatigue limit of low-Ni stainless steel was also attributed to the formation under the boride layer of a homogeneous carbide zone. A reduction in the fatigue limit of stainless steel containing more Ni was attributed to the presence of this element which affects the diffusion layer microstructure. (JRD)

Preparation and Fabrication

13207 (LA-tr–73-24) INFLUENCE OF ADDITIONS OF TRANSITION METALS ON THE SINTERING BEHAVIOR OF TUNGSTEN. Samsonov, G. V.; Yakovlev, V. I. Translated from Z. Metallk.; 62: 621-626(1971). 17p. Dep. NTIS $3.00.

The influence of additions of Ti, Hf, Nb, Ta, Cr, Re, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, and Pt in concentrations of 0.05 to 1.0 wt % on the sintering behavior of tungsten in the temperature range between 1000 and 2000°C and on its properties was studied. It was found that Ti, Hf, Nb, and Ta retard the sintering process, and Cr and the metals of the eighth group promote sintering, with the exception of Os, which does not exert any influence in either direction. The influence of transition-metal additions on the sintering behavior of tungsten may be explained by an electron exchange between the alloy components. With an increase in the stable d-bonds in the system, and free energy is lowered and the sintering process is activated. The sintering diffusion is accelerated by alloying additions for which tungsten acts as an electron donor. (22 references) (auth)

13208 (MLM-1972) CONVENTIONAL DRAWING OF Pt + 20 WT % Rh HEAT SOURCE (ACE) LINEAR BODIES. Pawlak, D. A.; Wyder, W. C. (Mound Lab., Miamisburg, Ohio). 15 Jun 1973. Contract AT-33-1-GEN-53. 16p. Dep. NTIS $4.00.

Fabrication is described of Pt + 20 wt % Rh liner bodies for a U. S. Army Corps of Engineers radioisotopic heat source similar in design to the Milliwatt Generator (MWG) heat source. Strain hardening, component design, and poor-draw-quality material required a two-stage drawing operation with an intermediate anneal. First and second draw tooling were designed, fabricated, and successfully applied in the forming of liner bodies to desired specifications. (auth)

13209 (N-73-16562) DEVELOPMENT OF ADVANCED HIGH STRENGTH TANTALUM-BASE ALLOYS. Part 1. Screening Investigation. Final Report, October 1967–4 July 1970. Buckman, R. W. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Dec 1971. Contract NAS3-10939. 68p. (NASA-CR-120818; WANL PR-71-1(Pt.1)). NTIS.

Five experimental tantalum alloy compositions containing 13 to 18% W + Re + Hf solid solution solute additions with dispersed phase strengthening achieved by carbon or nitrogen additions were prepared as 1.4-inch-diameter ingot processed to $^3/_8$-inch-diameter rod and evaluated. Elevated-temperature tensile and creep strength increased monotonically with increasing solute content. Room-temperature elongation decreased for 20% to less than 2% as the solute content was increased above 16%. Phase identification indicated that the precipitating phase in the carbide-containing alloys was Ta_2C. (auth)

13210 (ORNL-tr-2679) ELECTROCHEMICAL MACHINING. van Bentem, A. A.; van den Brekel, J. W. M.; Hofstede, A.; Matthysen, M. J. C. Translated from Metaalbewerking; 31; 32: No. 26; 1; 7; 8; 9; 10, vp (1966). 90p. Dep. NTIS $6.50.

The theory and present state of the art of electrochemical machining (ECM) are described. It is shown that the ECM process may be used in place of lathing, planing, drilling, reaming, and

three-dimensional contour machining for all electrically conductive materials that can be dissolved anodically. From the economical point of view ECM will be preferred over conventional machining when: (a) conventionally difficult-to-machine material has to be worked on; (b) the removal rate that can be achieved with conventional machining is unacceptable; (c) complicated shapes (three dimensional contours) have to be machined; (d) surface tensions as a result of machining are unacceptable; (e) very low surface roughness has to be achieved in a short time. The operation of the ECM machine does not pose any problems. The choice of operating conditions and the shape to be given to the electrodes should be considered carefully. The basic information that is needed is already to a large extent available. Greater accuracy can be obtained by using spark erosion. The present accuracy of ECM is in most instances more than sufficient, providing that a number of precautions are taken. Current estimates indicate that 5 to 10% of the machining now performed by conventional means can be done more economically by using ECM. This percent is about 20 to 30% in the airplane industry. These percents will increase when more difficult to machine materials have come into common use. ECM data are given for the following materials: Mo, Al, 316 stainless steel, steels, brass, various elements, Perunal, Nimonic, and titanium alloys. (DLC)

13211 (RDT-A-1-5-T(5-73)) PURITY REQUIREMENTS FOR OPERATING SODIUM REACTOR SYSTEMS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1973. 8p. RSO.

A standard prescribing purity requirements for operating sodium reactor systems is presented. (JRD)

13212 HISTORY OF DEVELOPMENT OF URANIUM AND THORIUM METALS. Wilhelm, H. A. (Ames Lab., IA). Trans. Amer. Nucl. Soc.; 16: 91(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13213 1972 NATIONAL POWDER METALLURGY CONFERENCE PROCEEDINGS, CHICAGO, ILLINOIS, APRIL 17-19, 1972. Bufferd, A. S. (Ed.). Progress in Powder Metallurgy, Volume 28. New York; Metal Power Industries Federation (1972). 322p. (CONF-720473-). $35.00.

Papers are presented on deformation of porous materials, powder consolidation processes, properties of consolidated powders, properties of Al powder metallurgy (P/M) products, sintered ferrous alloy parts, P/M tool steels, developments in Ti P/M, steel-bonded carbides, properties of sintered Fe compacts, powder forging, hot extrusion of sintered stainless steel, and state of the P/M industry. (JRD)

13214 EFFECT OF THE STATE OF THE GASEOUS ATMOSPHERE ON THE GROWTH AND PROPERTIES OF FILAMENTARY CRYSTALS. Taskaev, I. P. Fiz.-Khim. Mekh. Mater.; 8: No. 6, 105-106(1972). (In Russian).

A study of the conditions used in the experimental growing of filamentary crystals resulted in a set of recommendations for the optimum development of filamentary W, Mo, and Nb crystals: temperature, time of growth, pressure, and rates of gas flow. Formulas for the growth velocity are advanced and discussed. (KSW)

13215 SELECTIVE VAPORIZATION OF IMPURITIES FROM REFRACTORY METALS. Katrich, N. P.; Timan, B. L. Izv. Akad. Nauk SSSR, Metal.; No. 2, 67-68(1973). (In Russian).

A theoretical analysis of selective distillation of substances from refractory metals showed that crystallization from a thin layer of the melt may be one of the most effective techniques in the purification of refractory metals. Mixtures of W-C and W-Ti were employed as an illustrative example in the calculation of the degree of purity of W as a function of the rate of crystallization. (KSW)

13216 EXTRACTION OF OXYGEN FROM TUNGSTEN DURING ITS DISSOLUTION IN METAL CARBIDE MELTS IN A VACUUM. Burtsev, V. T.; Saksonova, L. N.; Kashin, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 2, 96-101(1973). (In Russian).

The relation of oxygen removal to the conditions of dissolution of a sample of tungsten during the course of the reaction $|C| + |O| \rightarrow CO$ was studied in the metals Fe, Co, Ni, and Pt saturated with carbon. The extraction of oxygen from W (~0.003%) during dissolution in a vacuum amounted to 100% in Pt + C, 50% in Co + C, 40% in Ni + C, and 20% in Fe + C. The corresponding coefficients of mass transfer of oxygen were 30, 23, 17 and 12×10^{-3} sec^{-1}. (KSW)

13217 DIFFUSION TITANIUM COATINGS ON REFRACTORY METALS. Shapovalov, V. P.; Kurasov, A. N. Izv. Akad. Nauk SSSR, Metal.; No. 2, 234-237(1973). (In Russian).

The structure, phase composition, microhardness, and concentration of Ti with respect to depth of diffusion Ti coatings on Mo, Ta, and W were studied. The Ti coatings were produced from the vapor phase in a vacuum. The diffusion kinetics of Ti into the refractory metals were measured, using micro x-ray analysis of the Ti distribution in the outer layers of Mo and Ta. (tr-auth)

13218 DEPOSITION OF CADMIUM FROM ITS CARBONATE IN A REDUCING ATMOSPHERE. Vorontsov, E. S.; Kaz'min, S. P.; Mikulin, A. M.; Mikhina, G. F. (Voronezh Polytechnic Inst., USSR). Prot. Metals (USSR) (Engl. Transl.); 8: No. 5, 567-569(1972).

Translated from Zashch. Metal.; 8: No. 5, 621-624(1972).

A double-dispersion method was devised for the deposition of Cd: $CdCo_3 \rightarrow CdO + CO_2$ and $CdO + B \rightarrow Cd + BO$. The use of H_2, CO, and C as the reductant B is considered, and thermodynamic calculations were carried out for ΔG^0 and log K_{eq} of the reactions involved. Results indicate that H_2 or CO should be a good reductant. Preliminary deposition experiments were carried out. Deposition of Cd directly from the oxide was less effective, indicating that the double dispersion (dissociation and reduction) promotes the sublimation of Cd. (DLC)

13219 ELECTRODEPOSITION OF A PALLADIUM-CADMIUM ALLOY. Vinogradov, S. N.; Kulagina, N. F.; Ruzanova, G. G.; Kudryavtsev, N. T. (Penza Polytechnic Inst., USSR). Prot. Metals (USSR) (Engl. Transl.); 8: No. 5, 558-559(1972).

Translated from Zashch. Metal.; 8: No. 5, 611-613(1972).

Conditions were investigated for deposition of Pd-Cd alloy, possessing low internal stresses, from an electrolyte containing Pd-amminochloride complex and Cd-ethylenediamine complex (total metal concentration = 20 g/l). Measurements included polarization curves, dependences of alloy composition and current yield on Cd content in electrolyte, and dependences of internal stresses, electric resistance, and microhardness of deposit on Cd content in alloy. Optimum conditions are given for obtaining 20% Cd alloys. (DLC)

13220 ELECTRODEPOSITION OF CADMIUM FROM PYROPHOSPHATE ELECTROLYTES. Kudryavtsev, N. T.; Selivanova, G. A. (Moscow Chemical-Technological Inst.). Prot. Metals (USSR) (Engl. Transl.); 8: No. 5, 535-537(1972).

Translated from Zashch. Metal.; 8: No. 5, 591-593(1972).

An investigation was made of the quality of the deposits, the current yields of the metal, and the kinetics of the deposition from pyrophosphate electrolytes without and with additions of ligands that increase the solubility of Cd. Polarization measurements on rotating disc electrodes show that the Cd deposition is accompanied by concentration polarization. A loose sludge is formed on the Cd electrodes, but this may be prevented by Triton B (0.1 M). Cd deposits obtained in this way are identical in corrosion resistance to those obtained from cyanide electrolytes. Conditions are recommended for Cd plating. (DLC)

13221 DISPLACEMENT REACTION IN THE CONCENTRATION CELLS INVOLVING LIQUID ZINC AND CADMIUM ALLOYS. Moser, Z.; Fitzner, K. (Inst. for Metal Research, Krakow). J. Electrochem. Soc.; 120: No. 7, 914-919(Jul 1973).

The equilibrium constant of the displacement reaction $Zn + CdCl_2 \rightarrow Cd + ZnCl_2$ occurring in the concentration cell $Zn(l)|ZnCl_2$ in $(LiCl-KCl)_{eut}$ $(l)|Zn-Cd(l)$ was determined on the basis of the following parameters: (i) ΔF^0_T of the displacement reaction assuming ideal solutions for the salt and metal phases; (ii) data of dilute solutions of zinc in cadmium; (iii) thermodynamic properties of dilute solutions of $ZnCl_2$ and $CdCl_2$ in LiCl-KCl eutectic obtained from formation cells. In this case of dilute solutions of zinc in cadmium the influence of displacement reaction is visible in the values of zinc activity coefficients at $X_{Zn} = 0.01$ molar fraction resulting in deviations from the linear dependence of $\ln \gamma_{Zn}$ vs. X_{Zn}. Investigations enabled the calculation of the correction for the measured emf values, which when taken into account prove the linear character of $\ln \gamma_{Zn}$ vs X_{Zn} over the range $X_{Zn} = 0.01$ to 0.1 molar fraction in Zn-Cd system. (9 figures, 15 references) (auth)

13222 MASS-SPECTROSCOPIC INVESTIGATION OF THERMODYNAMICS OF VOLATILIZATION, DISSOCIATION, AND REDUCTION OF OXIDES OF NONFERROUS AND RARE METALS. Kazenas, E. K.; Chizhikov, D. M.; Tsvetkov, Yu. V. pp 14-19 of Termodinamika i Kinetika Protsessov Vosstanovleniya Metallov. Chizhikov, D. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The oxides of a number of nonferrous and rare metals (W, Mo, Ni, Re, Zn, Cu, Pb, and Fe) were subjected to a mass-spectroscopic study of their volatility and dissociation behavior at high temperatures. The composition and vapor pressure of these oxides were determined at 800 to 1600°K; for W, Mo, Re and Pb polymeric metal oxides were detected in the gaseous phase, whereas com-

plete dissociation characterized the vapors of the oxides of Zn, Cu, Ni, and Fe. (tr-auth)

13223 EFFECT OF ADDITIVES ON THE MECHANISM OF REDUCTION OF β-URANIUM DIOXIDE BY HYDROGEN. Vlasov, V. G.; Pis'menko, V. T. pp 105-108 of Termodinamika i Kinetika Protsessov Vosstanovleniya Metallov. Chizhikov, D. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The kinetics of reduction of β-UO_3 by H_2 were studied when oxides of Mg, Ca, Sr, Y, Th, and Nb had been introduced into the lattice of the UO_2. The influence of such additives on the UO_2 reduction depended both on the nature of the oxide being reduced and on the nature of the impurity. A given added oxide varied in its behavior depending on its concentration. Nb_2O_5 reduced the reduction rate of UO_2; Th and Y oxides accelerated it. (KSW)

13224 KINETICS OF REDUCTION OF URANIUM OXIDES BY CARBON MONOXIDE. Shalaginov, V. N.; Vlasov, V. G. pp 108-111 of Termodinamika i Kinetika Protsessov Vosstanovleniya Metallov. Chizhikov, D. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The experimental results in connection with the reduction by CO of α-, β-, γ-, and ε-trioxides of U are discussed, with an evaluation of the effects of temperature and pressure on the rates of the reactions. Mechanisms of the various steps of the reactions are discussed in terms of adsorption–autocatalytic theory and the electron theory of catalysis and adsorption. (KSW)

13225 KINETICS OF REDUCTION AND PHASE TRANSFORMATIONS OF TUNGSTEN AND MOLYBDENUM OXIDES. Miroshnichenko, O. Ya.; Smirnov, K. P. pp 113-117 of Termodinamika i Kinetika Protsessov Vosstanovleniya Metallov. Chizhikov, D. M. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The kinetics of reduction by H_2 and by CO of WO_3 and MoO_3 were studied in the temperature range 400 to 850°C. Conversion vs temperature and conversion vs time curves were constructed. The composition of the reduction products was studied by x-ray, petrographic, and chemical methods. The reduction of WO_3 and MoO_3 proceeded stepwise with the formation of lower oxides in the regions $WO_{3.00}$ to $WO_{2.00}$ and $MoO_{3.00}$ to $MoO_{2.00}$. The further reduction of the two dioxides to the metal was accomplished in one step. (tr-auth)

13226 STUDY OF ELECTROLYTIC SEPARATION OF SILVER–CADMIUM ALLOY. Kudra, O. K.; Izbekova, O. V.; Gaevskaya, L. V. Visn. Kiiv. Politekh. Inst., Ser. Khim. Mashinobuduv. Tekhnol.; No. 8, 52-54(1971). (In Russian).

Cathode polarization and the composition of Ag–Cd alloys from a trilonate electrolyte are studied. It is demonstrated that the precipitation of the alloy begins after attainment of $D_{(lim)}$ with respect to Ag. As D is increased, the content of Cd in the alloy increases. Following attainment of the second $D_{(lim)}$ (for Cd), the composition of the alloy is stabilized and becomes independent of D. Mixing increases both $D_{(lim)}$, increases the content of Ag in the alloy and increases the permissible value of D. The yield per current of alloy increases with increasing D, particularly without agitation. As the content of Ag in the alloy increases, the hardness of the sediment passes through a maximum at 30 to 35% Ag. The intermediate resistance of the alloy is ~0.03 ohm with various Ag contents, which is near that of pure electrolytic silver. To produce an alloy containing 30 to 40% Ag, an electrolyte is recommended containing (mol/l) $AgNO_3$ 0.035, $CdSO_4$ 0.165, trilon B 0.3, pH 8 to 9 (adjusted by KOH), D 1 to 1.25 A/dm² without agitation or 7 to 8 A/dm² with intensive agitation. (JPRS)

Properties, Structure, and Phase Studies

Refer also to abstracts 12826, 12851, 13131, 14117, 14403, 14414, 14472, 14720, 14721, 14753–14756, 14761, 14798–14803, and 15128.

13227 (AD-737311) RESEARCH ON RARE-EARTH METALS AND COMPOUNDS AND DEVELOPMENT OF APPLICATIONS BASED ON THEIR MAGNETIC PROPERTIES. Final Technical Report, 2 November 1970–1 November 1971. Donoho, P. L.; Brotzen, F. R.; Salama, K.; Benningfield, L. V. Jr. (Rice Univ., Houston, Tex. (USA). Materials Science Lab.). 1 Dec 1971. Contract DAAH01-71-C-0259. 85p. NTIS.

Results are given on the magnetic and magnetoelastic properties of materials containing elements of the rare-earth series. A primary goal of this program was the development of highly efficient high-frequency ultrasonic transducers based on the extremely high magnetostriction found in most rare-earth materials. Work was carried out on the propagation of elastic waves in holmium and terbium single crystals, and results were obtained for the velocity and attenuation of such waves as functions of the temperature and the strength of an applied magnetic field. Single-crystal transducers of gadolinium and terbium have been constructed, and elastic-wave generation in these transducers was observed, although only preliminary results were attained. A new theory of magnetic and magnetoelastic effects in the rare earths was developed, and it promises to shed new light on these phenomena. A facility for the growth of large single crystals of rare-earth materials was constructed, making possible the study of a wide range of materials. (auth)

13228 (AD-745410) MAGNETOELASTIC PROPERTIES OF RARE-EARTH ELEMENTS AND COMPOUNDS. Semiannual Report, 5 November 1971–4 May 1972. Donoho, P. L.; Brotzen, F. R.; Salama, K.; Benningfield, L. V. Jr. (Rice Univ., Houston, Tex. (USA). Materials Science Lab.). 4 Jun 1972. Contract DAAH01-72-C-0285. 118p. NTIS.

Results are reported of a research program on the magnetic and magnetoelastic properties of rare-earth elements, alloys, and compounds. The research was concentrated in three major areas: studies on elastic-wave propagation in terbium at frequencies in the MHz range showed the existence of very strong field-induced acoustic birefringence in single-crystal specimens; magnetostrictive ultrasonic transducers in the form of thin polycrystalline films were constructed using several pure rare-earth elements and a terbium–iron compound; and a semiclassical theory of magnetoelastic interactions in rare-earth materials, based on an equation-of-motion approach to the dynamical behavior of magnetic materials, yielded results that are applicable to both the two preceding areas of research and which, in particular, should make possible the design of more efficient microwave ultrasonic transducers. (GRA)

13229 (ANCR–1097) HEAT-TO-HEAT VARIATIONS IN THE FATIGUE AND CREEP-FATIGUE BEHAVIOR OF AISI TYPE 304 STAINLESS STEEL, AND THE FATIGUE BEHAVIOR OF TYPE 308 STAINLESS STEEL WELD MATERIAL. Brinkman, C. R.; Korth, G. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). May 1973. Contract AT(10-1)-1375. 69p. Dep. NTIS $5.45.

Results from tests designed to characterize differences in the fatigue or creep-fatigue properties of four heats of Type 304 stainless steel are reported. These tests included strain controlled fatigue with and without tensile hold times as well as cyclic stress-strain curve generation at 593°C. Although differences in cyclic-hardening characteristics were found in the four heats of stainless steel tested, little or no difference in cyclic lifetime occurred, with or without tensile hold times, for three of the heats tested. The fourth heat (Heat No. 8043813) showed a remarkable resistance to creep-fatigue damage which was tentatively attributed to subtle differences in residual element chemistry. Bilinear constants were also calculated for the four heats, and comparisons are made between bilinear and cyclic stress strain curves. Results are also reported from strain controlled fatigue tests conducted on uniform gage specimens taken from several different positions and orientations within double-U groove heavy section stainless steel Type 304/308 weldments. Room temperature 593°C test results are reported from strain-controlled fatigue, cyclic stress-strain, and elastic anisotropy measurement tests. The fatigue resistance of the weldment material was found to be inferior to that of base material at room temperature; however, the degree to which it was inferior was specimen-orientation-dependent. At 593°C, specimens taken from a parallel orientation with respect to the weld seam exhibited a fatigue resistance that was nearly equivalent to that of the base material. Transverse and transverse fusion line material showed inferior resistance to base material at both room temperature and 593°C; however, comparison was difficult because of strain concentrations that occurred in the transverse weldment material. Extensive variations in apparent elastic properties, i.e., Young's Modulus and Poisson's ratio, were found to occur in weldment material at both room temperature and 593°C. (auth)

13230 (CEA-CONF–2236) ROOM-TEMPERATURE DUCTILITY OF DIFFERENT TYPES OF MOLYBDENUM AFTER DIFFERING ANNEALING. Robert, G.; Sainfort, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 13p. (In French). (CONF-720613–8). Dep. NTIS (U. S. Sales Only) $3.00.

From third international conference on thermionic electrical power generation; Jülich, Federal Republic of Germany (5 Jun 1972).

After irradiation at 1650°C, the molybdenum can for thermoelectronic emitters shows a marked increase in grain size and sometimes intergranular cracking. This intergranular embrittlement is dependent on grain size but must equally be linked to the presence of impurities and precipitates in the grain boundary, which can also limit the grain size. The increase in grain size was studied for different types of molybdenum annealed at high temperatures. The samples were manufactured by melting or sintering.

An electron-scanning study was made of grain boundary precipitates in samples fractured at –196°C. The samples manufactured by melting were found to have a greater tendency for increasing grain size than the sintered samples. This is due to the presence of fine refractory particles in the sintered product. The mechanical properties after annealing were studied by testing at room temperature. It can be seen from the results obtained that there is a greater fragility in all cases, except for the sample made by sintering and containing a fine dispersion of ZrO_2 particles. (auth)

13231 (CONF-730806-1) INTERCRYSTALLINE FRACTURE IN AN INTERNALLY OXIDIZED BCC ALLOY. Carpenter, R. W.; Liu, C. T. (Oak Ridge National Lab., Tenn.). 1973. 5p. Dep. NTIS $3.00.

Results of fracture morphology studies on internally oxidized tantalum (T-111) alloy are presented. Information and discussions are included on internal microstructure, mechanical properties, and fracture morphology. Results show that grain-boundary separation or intercrystalline fracture observed in the T-111 specimens can be described as localized ductile fracture. (JRD)

13232 (COO–3158-16) LATTICE STATICS OF INTERSTITIALS IN TUNGSTEN. Report No. 2013. Benedek, R.; Ho, P. S. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering; Thomas J. Watson Research Center, Yorktown Heights, N. Y.). 1973. Contract AT(11-1)-3158. 32p. Dep. NTIS $3.75.

A modified Green's function approach was applied to the calculation of lattice distortion fields and energies and volumes of formation for six interstitial configurations in tungsten. Two interatomic potentials, one fitted to the phonon spectrum and the other, derived by Johnson and Wilson, to elastic constants, were used in numerical calculations. Results for the energy of formation show considerable sensitivity to the form of the potential, as expected from previous work. An expression is derived for the volume of formation which includes a correction to the standard formula involving the defect strength divided by the bulk modulus. This correction term depends explicitly on the volume-dependent part of the crystal energy and vanishes for a Cauchy crystal. (5 tables) (auth)

13233 (COO–3429-10) MAGNETIC PROPERTIES OF Ln_3In INTERMETALLIC COMPOUNDS. Hutchens, R. D.; Wallace, W. E.; Nereson, N. (Pittsburgh Univ., PA. Dept. of Chemistry; Los Alamos Scientific Lab., N. Mex.). 1973. 12p. Dep. NTIS $3.00.

Results of magnetic studies of Ln_3In phases (Ln = Pr, Nd, Gd, Dy, and Er) are presented. All materials exhibited Curie–Weiss behavior in the paramagnetic regions with effective moments approximating $g\sqrt{J(J+1)}$ for the tripositive ion. Positive Weiss constants were observed indicating predominance of ferromagnetic exchange. Pr_3In and Nd_3In order ferromagnetically at 62 and 114°K, respectively. However, the ordered moment is less than 10% of gJ. Dy_3In and Er_3In also seem to order ferromagnetically, but with low moments compared to gJ. Gd_3In exhibits metamagnetic behavior with a critical field of about 5 kOe. Neutron diffraction measurements on Nd_3In indicate that it is ferromagnetic and confirm the low Nd^{+3} moment. (auth)

13234 (COO–3429-11) MAGNETIC CHARACTERISTICS OF $LnCo_5$–$ThCo_5$ PSEUDO-BINARY SYSTEMS. Wallace, W. E.; Swearingen, J. T. (Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 7p. Dep. NTIS $3.00.

Magnetic characteristics of $Ln_{1-x}Th_xCo_5$ (Ln = Gd, Ho, or Er) ternaries are reported. Th is introduced into the lattice in an effort to achieve ferromagnetic coupling. It is observed that the antiferromagnetic Ln–Co coupling, which exists in the $LnCo_5$ binaries, also persists in the ternaries. The cobalt moment and Curie temperature are reduced as the Th content of the sample is increased. The decreased cobalt moment is ascribed to electron transfer from Th to the cobalt d-shell. Failure to achieve ferromagnetism in the ternaries is ascribed to electron capture by cobalt, which prevents a rise in electron concentration as Th replaces Ln in the lattice. (auth)

13235 (COO–3429-12) LOW-TEMPERATURE HEAT CAPACITIES AND RELATED THERMAL PROPERTIES OF $TbAl_2$ AND $HoAl_2$. Hill, T. W.; Wallace, W. E.; Craig, R. S.; Inoue, T. (Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 16p. Dep. NTIS $3.00.

Heat capacities of $TbAl_2$ and $HoAl_2$ for the range 5 to 300°K are presented. The magnetic contribution, (C_p)mag., for $TbAl_2$ is very broad, resembling that for $GdAl_2$. (C_p)mag. for $HoAl_2$ is generally similar but, in addition, peaks in C_p are observed at 20 and 28°K. The measured magnetic entropies for the two compounds are only about 80% in R ln(2J + 1). The possibility cannot be excluded that the ground state is doubly degenerate in these cases. The data are treated to give values of the Third Law Entropy (S), H–Ho and F–Ho. (auth)

13236 (COO–3429-13) SPECIFIC HEAT OF $CeCo_2$ AT TEMPERATURES BETWEEN 1.5 AND 300°K. Nasu, S.; Bechman, C. A.; Craig, R. S.; Marzwell, N.; Wallace, W. E. (Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 18p. Dep. NTIS $3.00.

The heat capacity of $CeCo_2$ was measured in the ranges 1.5 to 13°K and 8 to 300°K. Results in the liquid helium range show a marked deviation from the usual relation $C/T = \gamma + \beta T^2$, giving a minimum at $T^2 \approx 5°K^2$ when C/T is plotted against T^2. The results are discussed in terms of spin fluctuation effects, suggested by the work of Doniach and Engelsberg, and of the magnetic cluster effect described by Schröder. An approximate enhancement factor λ_t involving electron–phonon and electron–electron interactions is given. The large heat capacity near room temperature may be accounted for by an electronic contribution. The heat capacity behavior of $CeCo_2$ is similar in all respects to that previously observed for $CeNi_2$. (auth)

13237 (COO–3429-14) LOW-TEMPERATURE HEAT CAPACITIES OF $DyNi_5$, $HoNi_5$, AND $ErNi_5$. Bechman, C. A.; Wallace, W. E.; Craig, R. S. (Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 6p. Dep. NTIS $3.00.

Measurements were made over the 1 to 15°K range, and results are plotted along with earlier data for $LaNi_5$. The magnetic contribution to the heat capacity is seen to be over 90% of the total at 4°K, and there is only one peak for each of $DyNi_5$, $HoNi_5$, and $ErNi_5$. Results are discussed with respect to λ-type thermal anomalies and the behavior of $GdNi_5$. Entropies associated with the thermal anomalies and Curie temperatures indicated by the thermal measurements are given. (DLC)

13238 (COO–3429-15) LOW-TEMPERATURE HEAT CAPACITY STUDIES OF $DyFe_3$, $DyCo_3$, $DyNi_3$, AND $LaNi_3$. Narasimhan, K. S. V. L.; Butera, R. A.; Craig, R. S.; Wallace, W. E. (Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 17p. Dep. NTIS $3.00.

Low temperature heat capacity measurements were made on $DyFe_3$, $DyCo_3$, $DyNi_3$, and $LaNi_3$ over the temperature range 1.4 to 15°K. Two anomalies, observed at 1.8 and 9.3°K, are ascribed to the presence of an oxide and a hydride. Another anomaly exists at 3.2°K, which may be due to hydroxide. The electronic specific heat coefficients observed for these materials is interpreted in terms of their band structure. (auth)

13239 (COO–3429-16) NEUTRON-DIFFRACTION STUDIES OF $ThNi_2Co_3$ AND $ThNi_3Co_2$ AT 297 TO 5°K. Atoji, M.; Atoji, I.; Do-Dinh, C.; Wallace, W. E. (Argonne National Lab., Ill.; Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 19p. Dep. NTIS $3.00.

Neutron powder diffraction measurements of $ThNi_2Co_3$ and $ThNi_3Co_2$ show that, in the 5 to 297°K range covering both the ordered and disordered magnetic phases, the Ni and Co atoms are distributed in (c); (⅓, ⅔, 0), (⅔, ⅓, 0) and (g); (½, 0, ½), (0, ½, ½), (½, ½, ½) of D_{3h}^1 – P(6/m)mm with the following occupancy distribution: In (c), 1.10 Ni + 0.90 Co and 1.50 Ni + 0.50 Co; in (g), 0.90 Ni + 2.10 Co and 1.50 Ni + 1.50 Co, in $ThNi_2Co_3$ and $ThNi_3Co_2$, respectively. Hence, the numbers of the Co atoms in (c) and (g) in $ThNi_{5-5x}Co_{5x}$ ($0 \le x \le 1$) are likely given by the interpolation formulae, $(5x^2 + 3x)/4$ and $(-5x^2 + 17x)/4$, respectively. This implies that the atomic concentration of the larger moment carrier, e.g. Co, is higher in (g) than in (c) at any given x in $0 < x < 1$. A reversed relation was postulated by van Diepen et al. for the isostructural ternaries $ThCo_{5-5x}Fe_{5x}$ and $ThNi_{5-5x}Fe_{5x}$; thus in these materials, Co and Ni preferentially occupy the 3g sites. The spontaneous ordered ferromagnetic moments of our systems are too small to give rise to the detectable magnetic intensity. Nevertheless, the diffraction effect due to the torque-induced preferential alignment of the powder particles in the external magnetic field verified that the moment direction is the c axis in both $ThNi_2Co_3$ and $ThNi_3Co_2$. The field-induced ferromagnetic moment above the Curie temperature aligns also in the c direction and is particularly large in $ThNi_2Co_3$. (auth)

13240 (COO–3429-17) MAGNETIC AND ELECTRICAL CHARACTERISTICS OF TERNARY SYSTEMS INVOLVING RARE EARTHS AND d-TRANSITION METALS. Wallace, W. E.; Craig, R. S.; Rao, V. U. S.; Butera, R. A. (Pittsburgh Univ., PA. Dept. of Chemistry). 1973. 19p. (CONF-720978–2). Dep. NTIS $3.00.

From seventh conference on rare-earth metals alloys and compounds; Moscow, USSR (12 Sep 1972).

Studies reviewed include establishment of phase relationships and determination of bulk magnetic properties and the dependence of resistivity on temperature. The studies indicate that the rare earth interaction is insensitive to the magnetic nature of the

other component in the system. Reversal of the anisotropy in a number of R_2Co_{17} compounds was achieved by alloying. Attempts to reverse the intersublattice coupling in rare earth d-transition metals by altering the electron concentration were unsuccessful; probable reasons for the failure are given. Numerous examples of the influence of the crystal field interaction on magnetic and electrical characteristics of rare earth systems are given. Pr^{+3}, which exists in a Γ_1 state in $PrNi_2$, becomes magnetic when it is partially replaced by Ho^{+3} or Dy^{+3}. Complex resistivity–temperature behavior is observed for the $Ce_{1-x}La_xPd_3$ system, presumably because of the interplay between the Kondo and crystal field interactions. One crystallographic variety of Fe in $(R,Th)Fe_3$, with R = Gd, Y, or Lu, is shown to couple either ferromagnetically or antiferromagnetically depending on the temperature and/or the electron concentration. (15 figures, 21 references) (auth)

13241 (EUR–4820(Vol.2)(Pt.D), pp 21-37) STRESS ANALYSIS OF A BIMETALLIC CYLINDRICAL JOINT. Blanckenburg, J.; De Windt, P.; Putzeys, J.; Reynen, J. (EURATOM, Ispra, Italy). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The thermo–elasto–plastic stress problem of a bimetallic cylindrical joint, formed by an explosive-welding technique of a Zr–Nb pressure tube to a stainless steel primary circuit is described. A finite-element technique, using a triangular constant strain element, was used. Local yielding is accounted for by assuming the von Mises yielding hypothesis and an isotropic strain-hardening rule. (auth)

13242 (EUR–4820(Vol.2)(Pt.D), pp 129-144) THERMAL STRESSES IN CIRCULAR CYLINDER WITH A RECTANGULAR HOLE UNDER HEAT GENERATION. Takeuti, Y.; Noda, N. (Shizuoka Univ., Japan). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A new treatment for solving the thermal-stress problem in a thick circular cylinder having a rectangular hole with round corners, under uniform heat generation, is given. The analysis is treated by using the complex variable approach, utilizing a double-perturbation technique. (auth)

13243 (EUR–4820(Vol. 6)(Pt. L), pp 27-40) TEMPERATURE AND DEFORMATIONS IN RODS AND PLATES MELTING UNDER INTERNAL HEAT GENERATION. Boley, B. A. (Cornell Univ., Ithaca, NY). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Some basic problems concerning melting plates under conditions which may be expected in nuclear reactors are considered. These include the development of an exact analytical solution for a plate melting under the action of internal heat generation, an outline of an approximate solution for the same problem, an estimate of the time required for total melting and the construction of a lower bound for that time. The deformations of the melting plate are then treated, and the accuracy of the use of a purely elastic analysis is assessed. (auth)

13244 (EUR–4820(Vol. 6)(Pt. L), pp 133-148 MATHEMATICAL MODEL FOR ELEVATED-TEMPERATURE DEFORMATION BEHAVIOR OF STRUCTURAL METALS. Krempl, E. (Rensselaer Polytechnic Inst., Troy, NY). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The salient features of the isothermal deformation behavior of structural metals subjected to monotonic, static, and slowly varying loads are documented. These features include the total time-dependent picture (strain-rate sensitivity, creep, relaxation, and cyclic hardening or softening), the effect of prior deformation history and the response to hydro-static loading. The materials considered are metallurgically stable in the sense that exposure to temperature alone will not change their mechanical properties. (LMT)

13245 (EUR–4820(Vol. 6)(Pt. L), pp 161-178) SIMPLE ANALYSIS OF STRESS–STRAIN–TEMPERATURE–TIME BEHAVIOUR AND ITS CHARACTERIZATION IN METALS AND ALLOYS. Quaase, S. T. (Australian Atomic Energy Commission, Coogee). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The well-known lack of any general relationships between stress, strain, and temperature–time in materials is a great handicap to the completion of a firm bridge between two disciplines–metallurgy and engineering stress analysis–in particular, to those who prepare property data and to those who use it. The work presented here, which has been done over a number of years, shows that there are adequate general functions. It is important to note that the functions presented describe the general behavior of a real metal or alloy. No relationship to physical models is claimed. The approach adopted allows use of the vast amount of tabular data, already available, to prepare characteristic constants. (LMT)

13246 (EUR–4820(Vol. 6)(Pt. L), pp 217-229) ENGINEERING APPROACH TO THE USEFULNESS OF THE LINDEMANN LAW FOR THE SETTING OF STRESS LIMITS. Kanter, J. J. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In an attempt to find a rational ASME Code temperature limitation of metals and alloys, in 1965 the author became aware of the Lindemann Law relevance to the cohesive properties of materials. The relationship, discovered by the writer, $[\ln \sigma/\sigma_0 = (-\nu/\nu_M) = -\sqrt{T/T_M}]$, where σ = atomistic load, ν = Lindemann frequency, and T = temperature, °K, is valid to near the melting points of the elemental polycrystalline metals. From this relationship, it may be argued that an entropy change of 10.542 calories °C is active when elemental metal is stressed beyond the threshold of indefinitely long time-to-rupture. When the relationship is inverted it reveals the temperature of creep activation and the energetics from which various aspects of "creep damage" may be assessed. (auth)

13247 (EUR–4820(Vol. 6)(Pt. L), pp 231-250) INFLUENCE ON THE PLASTIC WAVE PROPAGATION OF THE VARIATION OF YOUNG'S MODULUS WITH PLASTIC STRAIN. Cristescu, N. (Univ., Bucharest). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The influence of the variation of Young's modulus with the plastic strain on the overall picture of the propagation of plastic waves in a bar, particularly on the unloading process, is examined here. The decrease of Young's modulus produces a decrease in velocity of propagation of the elastic unloading waves. Therefore, this velocity becomes variable from point to point in the bar, and the unloading process is generally delayed. The results obtained by numerical integration of the equation of motion are compared with experimental data of J. F. Bell and with the computed case obtained by assuming E = constant. (auth)

13248 (EUR–4820(Vol. 6)(Pt. L), pp 391-411) COMPARISON OF COMBINED TEMPERATURE AND MECHANICAL STRAIN CYCLING DATA WITH ISOTHERMAL FATIGUE RESULTS. Stentz, R. H.; Berling, J. T.; Conway, J. B. (Mar-Test, Inc., Cincinnati, OH). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Special control circuits have been developed to permit the evaluation of materials under combined temperature and mechanical strain cycling. This technique involves the separation of the thermal-expansion component from the mechanical-strain component caused by the applied load. Independent programming and control of each component is obtained through the use of separate closed-loop systems. Hourglass-shaped specimens, diametral-strain measurements, and axial-force measurements are employed to accurately identify maximum strains and to minimize thermal-gradient problems. The precision closed-loop systems contain built-in analog computers to provide axial-strain control using diametral-strain measurements. Combined temperature and mechanical-strain cycling tests were performed using annealed AISI 304 stainless steel specimens. The total strain range employed was 2.0% and the test temperature was cycled between 800 and 1200°F. Hold periods of 4.75 minutes duration were imposed in either the tension or compression portions of the cycle, and the effect of temperature phasing was also studied. It was found that when the highest temperature occurred at the peak tensile strain, the fatigue life was considerably reduced in comparison to isothermal data at the peak temperature. When the lowest temperature (800°F in these tests) was caused to coincide with the peak tensile strain, the difference between tension and compression hold periods was negligible. A correlation between isothermal and combined temperature and mechanical strain cycling data is presented to allow estimates to be made of the fatigue behaviour to be expected under various conditions. (auth)

13249 (EUR-4820(Vol. 6)(Pt. L), pp 413-432) CRITERION FOR BIAXIAL FATIGUE OF MILD STEEL AT LOW ENDURANCE. Havard, D. G. (Ontario Hydro Research Labs., Toronto); Topper, T. H. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Results of a program of fatigue tests on mild steel are reviewed. Uniaxial, torsional, and five biaxial stress states were applied with full reversal and principal strain control. The plastic strain and stable stress range data are related to fatigue life by the Coffin-Manson and Basquin laws. The slopes of the Coffin-Manson curves depend on stress ratio according to a relation based on the energy imparted to the planes of maximum shear stress. Stable cyclic stress-plastic strain curves for each stress ratio are normalized using octahedral stresses and strains. Fatigue strength at 10^4 cycles can be adequately described, in terms of stable stress, by a modified maximum shear stress criterion. This criterion includes a small influence of the stress normal to the plane of maximum shear. From these relations a criterion is developed that predicts fatigue life from range of principal strain for all stress states. Comparison of the experimental data with other criteria presently in use reveals nonconservative discrepancies. The proposed criterion offers significant improvement. (auth)

13250 (EUR-4820(Vol. 6)(Pt. L), pp 433-455) CYCLIC DEFORMATION AND FATIGUE BEHAVIOUR OF AXIAL AND FLEXURAL MEMBERS: A METHOD OF SIMULATION AND CORRELATION. Jhansale, H. R.; Topper, T. H. (Univ. of Waterloo, Ont.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Deformation models incorporating the various features of cyclic inelastic response such as memory of prior history, transient hardening or softening, and cyclic relaxation or creep are essential in fatigue and shakedown analyses. Simple formulations of these features of cyclic response based on axial tests are combined into a digital-computer model capable of simulating overall material response. The application of this model to evaluate fatigue damage is illustrated with a suitable fatigue damage criterion, a linear damage summation rule and a realistic cycle-counting technique. Since the formulations governing cyclic stress-strain response are similar to those governing flexural response, the same model can be used to simulate the cyclic moment-curvature response, with a suitable modification of the parameters. A method of correlating deformation and fatigue behavior under axial and flexural conditions, based on the essential assumption that the cyclic stress-strain and fatigue properties derived from axial tests are applicable in flexural conditions, is presented. Some results of experimental studies supporting the above techniques of correlating and simulating deformation and fatigue response are also included. Although the complex nature of the problem has necessitated some simplifying approximations, the method is considered adequate for engineering analysis. (auth)

13251 (EUR-4820(Vol. 6)(Pt. L), pp 457-471) DESIGN OF MILD STEEL STRUCTURES UNDER LOW-ENDURANCE FATIGUE CONDITIONS. Krishnasamy, S.; Sherbourne, A. N. (Univ. of Waterloo, Ont.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The response of determinate, mild steel beams is observed under conditions of fully reversed moment where strain and load are controlled, respectively. Moment-curvature models are developed for the two cases under consideration, paying particular attention to creep effects that arise in the load-control situations. These models are used to check the response of cantilever beams to tip loads. (auth)

13252 (EUR-4820(Vol. 6)(Pt. L), pp 615-635) BASIS FOR DESIGN ON ALLOWABLE PLASTIC STRAIN. Spretnak, J. W. (Ohio State Univ., Columbus). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Two basic fracture modes are examined, namely: plastic instability in pure shear and pore formation and joining. The necessary conditions for the former are (1) a free surface, (2) a stress gradient, and (3) the material must simulate the ideally plastic body. The latter is likened to the "separation" phenomenon in boundary-layer flow. Possible interactions of those modes in the creep range are discussed. Ramifications of the instability mode in plane stress situations are explained. (auth)

13253 (IS-T-580) EFFECT OF NITROGEN ON THE STRENGTH OF THORIUM. McLachlan, D. R. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 94p. Dep. NTIS $6.75.

Thesis. Submitted to Iowa State Univ. of Science and Technology, Ames.

The flow stress of the thorium-nitrogen alloys containing 0.16 to 0.97 at. % nitrogen was measured over a temperature range from 4.2 to 873°K. Constant strain rate and constant stress measurements of the flow stress were made at strain rates ranging from 10^{-12} to 10^{-3} per second. It was found that the flow stress could be divided into a thermally activated and an athermal stress component. The thermally activated component increased linearly with nitrogen content from 198 to 360°K and increased with the square root of nitrogen content at 77 and 4.2°K. The athermal component was found to be nearly independent of nitrogen content and temperature. The strengthening of thorium by nitrogen was primarily due to a strong interaction between randomly distributed nitrogen atoms and glissile dislocations. Age hardening could be produced in thorium-nitrogen alloys which were above the solubility limit of nitrogen in thorium. The aged alloys contained thorium nitride particles less than 10 atom diameters, 36Å, in size which greatly increased the flow stress of the metal. The temperature and strain rate dependence of the flow stress were used to determine the activation energies and activation volumes of the rate controlling processes. (5 tables, 24 figures, 56 references) (auth)

13254 (JINR-P14-7026) POSSIBLE STUDY OF NUCLEAR MAGNETISM IN VAN VLECK PARAMAGNETICS USING NEUTRON SCATTERING. Hennig, K.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Neutron Physics). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possible study of nuclear magnetism in Van Vleck paramagnetics using the pulse reactor at superlow temperature is discussed. The neutron-diffraction method is shown to be promising due to the comparatively high intensity of peaks connected with the ordering of the nuclei and due to possible separation of nuclear and electron magnetism effects through the scattering angular dependence. A search experiment is suggested: direct observation of nuclear antiferromagnetism in intermetallic compound $PrCu_2$ by neutron diffraction at temperatures below 50 mK. (auth)

13255 (MLM-2037) EFFECT OF OXYGEN AND TEMPERATURE ON THE IMPACT BEHAVIOR OF T-111 (Ta-8% W-2% Hf). Schaeffer, D. R. (Mound Lab., Miamisburg, Ohio). 1 May 1973. Contract AT-33-1-Gen-53. 57p. Dep. NTIS $5.45.

Thesis. Submitted to Ohio State Univ., Columbus.

Results of a study conducted to determine how the oxygen content affects the impact properties of T-111 and how the effect varies with temperature. T-111 samples with oxygen contents varying from the as-received material to 4000 ppM were impacted at temperatures ranging from room temperature to 1000°C, the ultimate result being the maximum amount of oxygen that can be tolerated in T-111 if ductile behavior is to be expected at a specific temperature. (auth)

13256 (N-72-30502) DEVELOPMENT OF PLATINUM-THORIUM OXIDE ALLOY FOR RESISTOJET THRUSTER USE. Final Report. Albert, H. J.; Hill, J. S. (Engelhard Industries, Newark, N. J. Research and Development Dept.). Jul 1971. Contract NAS1-10433. 37p. (NASA-CR-111959). NTIS.

Testing of platinum-thoria alloys has established that, under the conditions determined for the preparation of these alloys, platinum with 0.6% thoria is the optimum composition from the point of view of manufacturing and usage of the alloy. Stress-rupture test results show a considerable increase in stress-rupture life for platinum-thoria alloys over the commercial platinum-rhodium alloys. Adding thoria to platinum at the 0.6% level has relatively little effect on the room temperature mechanical and electrical properties. The principal effect of the thoria is to provide a stable, elongated grain structure, thereby improving the long-term, load-carrying capacity at elevated temperatures. Tubing was fabricated without difficulty from the platinum 0.6% thoria alloys. Joining tests were carried out by electron-beam welding, dap welding, diffusion bonding, spot welding, and high-temperature brazing. (auth)

13257 (NAA-SR-9875) PARAMETRIC STUDIES ON THE SHORT-TERM TENSILE MECHANICAL PROPERTIES OF Zr-10 U ALLOY HYDRIDES. Lundberg, L. B. (Atomics International, Canoga Park, Calif.). 15 Jul 1964. Contract AT(11-1)-Gen-8. 43p. Dep. NTIS $4.25.

Declassified 3 May 1973.

Short-term tensile test methods were developed, and tests performed, on Systems for Nuclear Auxiliary Power (SNAP)

fuel (zirconium–10 wt % uranium alloy hydride). The effects on the mechanical behavior, resulting from variations in the hydrogen content (in the range of 1.45 to 1.94 H/Zr) and small additions of carbon alloy modifier, were studied from room temperature to 1450°F. Hydrogen content was found to have its greatest effect on the Young's modulus of this material; the modifier had its greatest effect on the ultimate tensile strength. Temperature affected both these properties, but to a lesser degree than the other two parameters. Cleavage of the ϵ hydride was observed to occur approximately along the basal plane (100) of the tetragonal structure. (auth)

13258 (ORNL-TM-4173) INFLUENCE OF VARIOUS ALLOYING ADDITIONS ON THE STRENGTH OF NICKEL-BASE ALLOYS. McCoy, H. E. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 40p. Dep. NTIS $4.00.

The effects of Mo, Cr, Fe, Si, and Mn on the strength of nickel-base alloys at 25 and 650°C were studied. The strength at 25°C was enhanced by Mo and Cr but not significantly affected by Fe, Si, and Mn in the concentrations studied. At 650°C the yield stress and the creep strength were improved by additions of Mo, Cr, and Si, while Fe and Mn had no measurable effect. These changes are thought to be a result primarily of solid-solution hardening, although Mo, Cr, and Si influence the type of carbide that is formed. (auth)

13259 (ORNL-TM-4253) THERMOPHYSICAL PROPERTIES OF URANIUM-BASED Mo, Nb, Zr, Ti ALLOYS FROM 77 TO 1500 K. Kollie, T. G.; Moore, J. P.; McElroy, D. L.; Whaley, H. L.; Williams, R. K.; Godfrey, T. G.; Ewing, W. M.; Graves, R. S. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 49p. Dep. NTIS $4.50.

The temperature dependencies of the thermal expansion, specific heat capacity, electrical resistivity, thermal conductivity, Seebeck coefficient, Poisson's ratio, and the shear, Young's and bulk moduli of two uranium-based alloys supplied by AMMRC (QUAD 1 and QUAD $^3/_4$) were measured from 77 to 1460°K. In addition, the room-temperature density and hardness and the liquidus and solidus temperatures were determined. Generally, the properties of the alloys were quite similar to those of pure alpha- or gamma-uranium in their corresponding temperature intervals of stability. Optical microscopy and x-ray diffraction at room temperature revealed that these were multiphased alloys, with the predominate phase being orthorhombic alpha-uranium. (auth)

13260 MECHANICAL PROPERTIES OF A POTENTIAL PULSED REACTOR FUEL, U–6 WT % Mo. Horak, J. A. (Sandia Labs., Albuquerque, NM); Yao, E.; Sasmor, D. J. Trans. Amer. Nucl. Soc.; 16: 80-81(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13261 DEFORMATION AND FRACTURE BEHAVIOR OF U–6 WT % Mo FUEL. Yao, E. (Univ. of New Mexico, Albuquerque); Horak, J. A.; Rorke, G. L.; Sasmor, D. J. Trans. Amer. Nucl. Soc.; 16: 81(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13262 QUANTITATIVE STRAIN AND STRESS STATE CRITERION FOR FAILURE IN THE VICINITY OF SHARP CRACKS. Walker, T. G. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 16: 100(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13263 FACTORS CONTROLLING THE STRUCTURE OF SPUTTERED Ta FILMS. Feinstein, L. G.; Huttemann, R. D. (Bell Telephone Labs., Inc., Allentown, PA). Thin Solid Films; 16: No. 2, 129-145(May 1973).

The role of the chemical nature of the substrate surface in the formation of either β- or bcc-Ta, deposited by dc and rf diode sputtering, was studied. The twenty different substrates investigated fall into three groups: (I) oxides, such as glass, or substrates that readily form surface oxides in air at room temperature, e.g., Cu, nucleated β-Ta; (II) substances such as Au that do not readily form oxides nucleated bcc-Ta; (III) substances that do not rapidly form surface oxides in air at room temperature, but which may be oxidized at elevated temperatures, e.g., Ta_2N, nucleated bcc-Ta when freshly prepared and β-Ta when oxidized. The formation of β-Ta or bcc-Ta is determined in the nucleation step. Once the bcc phase has been nucleated, it grows regardless of impurities in the sputtering chamber. However, β-Ta nucleating substrates yield bcc-Ta films in the growth stage if incorporated impurities exceed the solubility limit of the β-phase. It is concluded that β-Ta is a metastable allotrope. The presence on the substrate surface of O, or OH formed by reaction of H_2O with the surface oxide, is necessary for the nucleation of β-Ta, but the presence of impurities is not necessary during the growth stage. (61 references). (auth)

13264 APPLICATION OF MICROREFLECTION IN METALLOGRAPHY. Petzow, G.; Knosp, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Metallography; 6: No. 3, 249-260 (Jun 1973).

A short description of a modern microscope–photometer and its practical applications of reflection measurements in metallography are given. The dependence of the reflectivity on different polishing methods is demonstrated. Furthermore, methods for determining the composition and the optical constants of solid solutions are given. (auth)

13265 CRYSTAL STRUCTURE INVESTIGATION OF THE EUTECTOID DECOMPOSITION IN COPPER–BERYLLIUM ALLOYS. Ordering with Formation of a Metastable Solid Solution of Cu_2Be. Tyapkin, Yu. D.; Golikov, V. A. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 35: No. 2, 336-346(1973). (In Russian).

The initial stages of decomposition of alloys of eutectoid composition of the system Cu–Be (24 to 31 at. % Be) were investigated by electron-microscopic methods using microdiffraction. An intermediate metastable β''-phase was formed in the alloys during quenching which was ordered according to the type previously known (Cu_2Be). The structure of this phase may be represented by alternating in one of the directions ⟨001⟩ of the original bcc lattice of (001) planes, enriched by Cu or Be. The following relationship of lattice parameters is obtained as a result: $\alpha_{\beta''} \approx \alpha_{bcc}$; and $C_{\beta''} = 3\alpha_{bcc}$. By means of photometric measurement of the pattern, the upper limit of the degree of long-range order in this phase ($\eta < 0.4$) was determined. (tr-auth)

13266 MORPHOLOGY OF STRUCTURE AND MICROHARDNESS OF EUTECTIC COMPOSITIONS OF Al–(Ni, Cu, Be, Fe, Co). Kurilo, Yu. P.; Somov, A. I.; Tortika, A. S.; Chernyi, O. V. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 2, 347-354(1973). (In Russian).

The anisotropy of microhardness of crystallized eutectics was investigated, and the effect of the degree of dispersion of the eutectic components on the microhardness and its anisotropy was studied. It was found for the series of eutectic systems Al–Al_3Ni, Al–Al_2Cu, Al–Be, Al–Al_3Fe, and Al–Al_9Co_2 that an anisotropy of microstructure involves an anisotropy in microhardness. Various types of anisotropy in microhardness were studied in the eutectic Al–Al_3Ni. It was shown that the anisotropy in microhardness, expressed through a difference in the diagonal lines of the diamond indentor, depended on the mutual orientation of the eutectic framework and the diagonals of projection of the pyramidal impression of the surface of the ground end. It was established that the microhardness of the indicated eutectic microstructure was inversely proportional to the square root of the distance between particles of the eutectic framework. (tr-auth)

13267 DECOMPOSITION OF THE SOLID SOLUTION OF INTERSTITIAL IMPURITIES IN MOLYBDENUM DURING RECRYSTALLIZATION. Zueva, I. B.; Mezhennyi, Yu. O.; Skakov, Yu. A. (Moscow Inst. of Metal and Metal Alloys). Fiz. Metal. Metalloved.; 35: No. 2, 389-397(1973). (In Russian).

Changes in the dislocated structure and redistribution of impurities during annealing of deformed Mo alloys (type TsM-2A) were studied by diffraction electron microscopy and precision measurement of the crystal lattice constants. Recrystallization failed to accelerate the processes of disintegration of the solid solution; they either preceded recrystallization or they suppressed it (for a coincidence of the temperature ranges of recrystallization and decomposition). This was a result of the interaction of the incorporated atoms with the vacancies produced during the original recrystallization. (tr-auth)

13268 MICROSTRUCTURAL CHARACTERISTICS OF CAST COPPER–ZIRCONIUM ALLOYS. Bozic, B. I.; Mihailovic, D. V.; Kostic, M. L. Bull. Soc. Chim. Beograd; 35: No. 7-8, 405-414 (1970). (In Serbo-Croatian).

Copper alloys containing Zr up to 1.2% were cast in metal molds heated to 200°C, and their microstructures were analyzed under metallographic and electron microscopes and correlated with measurements of electrical resistance and microhardness. The microhardness, in particular, varied markedly from place to place as a result of dendritic segregations, these variations being very little alleviated by annealing at temperatures up to 900°C, at any rate over the first hour. Prolonged aging produced slow changes in these characteristics. (Metals Abstr.)

13269 EFFECT OF VACUUM ANNEALING ON PROPERTIES OF TYPE MS MOLYBDENUM WIRE. Nechiporenko, E. P.;

Kirillov, V. S.; Lukirskii, Yu. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 186-190(1973). (In Russian).

The mechanical properties (strength and relative elongation) and the microstructure of type MS Mo wire were tested after a ten-minute annealing at 900 to 2000°C in a vacuum of 10^{-6} torr. This annealing process was repeated with and without the use of a sorption trap in connection with the oil diffusion pump. It was shown that the residual gases from the annealing process had a definite effect on the mechanical properties of type MS Mo. (KSW)

13270 CALCULATIONS BY THE RULE OF ADDITIVITY OF SPECIFIC VOLUME OF MELTS IN BINARY SYSTEMS NEAR LIQUIDUS TEMPERATURES. Novikov, I. I.; Korol'kov, G. A.; Arutyunyan, V. N. Izv. Akad. Nauk SSSR, Metal.; No. 2, 69-71 (1973). (In Russian).

It is customarily considered that in a binary system at constant temperature, the specific volume of the alloy is an additive quantity derived from the specific volumes of the liquid components at that temperature. A comparison of data taken from the literature showed that this additivity rule holds to within 1%. In a system containing congruently melting compounds at liquidus temperatures, values for the specific volumes of metals and compounds must be used. The binary systems employed for illustrative purposes included Cd and In. (21 references) (KSW)

13271 EFFECT OF ADDITIONS OF RARE-EARTH METALS ON ELECTROCHEMICAL AND MECHANICAL PROPERTIES OF CHROME AND CHROME–MOLY CAST IRON. Kirievskii, B. A.; Luneva, N. I.; Tikhonovich, V. I. (Inst. of Casting Problems, Kiev). Fiz.-Khim. Mekh. Mater.; 8: No. 6, 16-18(1972). (In Russian).

The optimum quantity of rare-earth (RE) metals used as additives to chromium and chromium–molybdenum cast irons to achieve maximum corrosion resistance was determined (corrosion rate was at a minimum at 0.3% RE). The static potential in base and acid solutions (max E at 0.35% Ce) and anode dissolution curves were also obtained. The hardness of the cast irons was enhanced by the addition of rare earth metals; at about 0.2% Ce, a maximum was reached. (KSW)

13272 GALVANO-ELASTIC PROPERTIES OF WIRE AND RIBBON OF MICRON CROSS SECTION FROM MOLYBDENUM–RHENIUM ALLOY MR-47VP. Shnyrev, G. D.; Klimov, K. M.; Soldatov, V. M. Izv. Akad. Nauk SSSR, Metal.; No. 2, 191-194 (1973). (In Russian).

Very fine wire and ribbon of the Mo alloy MR-47VP were subjected to elastic stretching with a special apparatus. The electrical resistance of the samples was measured with a constant current bridge. The coefficient of tension sensitivity was practically independent of the degree of plastic deformation and of the change in temperature of the test sample in the range –196 to 200°C, a brief heating to 500 to 600°C, and annealing in a H_2 atmosphere at 1350°C. The coefficient of tension sensitivity was weakly dependent on the original diameter of the wire. (tr-auth)

13273 PHASE DIAGRAM OF V–Sn. MARCHUKOVA, L. V.; Matveeva, N. M.; Kornilov, I. I. Izv. Akad. Nauk SSSR, Metal.; No. 2, 207-211(1973). (In Russian).

The phase diagram of the V–Sn system was constructed from thermal data, microstructure and x-ray studies, and measurements of the thermal emf, hardness, microhardness, as functions of composition. Peritectic (1600°C) and monotectic (1500°C) equilibria exist. The compound (V_3Sn_3) occurs at ~260 to 750°C. The eutectic reaction $L \rightleftharpoons \delta + Sn$ was present at ~220°C. The solubility of Sn in V increased from about 10 to about 15% with a rise in temperature from 600 to 1550°C. Physical and metallurgical characteristics of the compound V_3Sn (δ-phase) are listed. (tr-auth)

13274 THERMODYNAMIC PROPERTIES OF U–Fe ALLOYS. Lebedev, V. A.; Nazarov, N. V.; Pyatkov, V. I.; Nichkov, I. F.; Raspopin, S. P. Izv. Akad. Nauk SSSR, Metal.; No. 2, 212-216 (1973). (In Russian).

The thermodynamic properties of U–Fe alloys were investigated in the range 550 to 870°C by emf measurements of the cell: $U_{(s)}|KCl-LiCl-5$ wt% $UCl_3|U-Fe$. Interpretation of the results is presented with reference to the two compounds UFe_2 and U_6Fe known to be in equilibrium with the U–Fe system at known temperature and concentration ranges. (KSW)

13275 THERMODYNAMIC PROPERTIES OF Ce–Al ALLOYS RICH IN ALUMINUM. Kober, V. I.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P.; Yamshchikov, L. F. Izv. Akad. Nauk SSSR, Metal.; No. 2, 217-220(1973). (In Russian).

Emf measurements were made of the two cells $Ce_{(s)}|KCl + LiCl + 5$ wt% $CeCl_3|Ce-Al_{(sat)}$ and $Ce = Al_{(sat)}|KCl + NaCl + 5$ wt% $CeCl_3|Ce-Al$ were conducted in an Ar atmosphere over the temperature range 425 to 710°C. The temperature vs emf curves were two straight lines which intersected at 645°C. Data were obtained on the solubility of Ce in fused Al from 952 to 1130°K. (KSW)

13276 SOLUTION OF NITROGEN IN LIQUID METALS. Revyakin, A. V.; Kozina, L. N. Izv. Akad. Nauk SSSR, Metal.; No. 2, 79-82(1973). (In Russian).

The equations of Temkin and Shvartsman (1949) were used to determine solution types from thermodynamic data, and applied in the treatment of data on the solubility of nitrogen in liquid V (1930°C), Nb (2530°C), and Ta (3040°C) as function of the nitrogen pressure in the gaseous phase. (KSW)

13277 NOVYI KONSTRUKTSIONNYI MATERIAL: TITAN. (New Structural Materials: Titanium). Kornilov, I. I.; Boriskina, N. G. (eds.). Trudy 8-Go Nauchno-Tekhnicheskogo-Soveshchaniya po Metallurgii, Metallovedeniyu i Primeneniyu Titana. Moscow; Izdatel'stvo Nauka (1972). 220p.

The volume contains forty-three papers from the conference on titanium: the new structural material. Part I deals with metallochemistry and metal science of titanium and contains fourteen papers with studies dealing with the phase diagram of the Ti–W system and the phase diagram of alloys of the system Ti–Al–Nb noted. Also noted are papers entitled, "Transformations Occurring During Heat Treatment of Alloys of the System Ti–Mo Containing Aluminum, Zirconium, and Tin," and "Structural and Disintegration Characteristics of Nonstable β-Solid Solutions in Ti–V System." Part II deals with the mechanical and technological properties of titanium and its alloys and contains nine papers. Two papers, "The Effect of Structure and Stress Concentration on Mechanical Properties of Alloys Ti–Ta–Mo" and "Properties of the Stable β-Alloys Containing Titanium and Niobium" are noted. A total of twenty papers are included in Part III dealing with the corrosion properties and application of titanium and its alloys. (JCW)

13278 BULK AND SURFACE MAGNETOELASTIC WAVES IN TERBIUM AND DYSPROSIUM. Liu, S. H. (Ames Lab., IA). Int. J. Magn.; 3: No. 4, 327-335(Dec 1972).

The magnetostriction in heavy rare earths causes a strong coupling between the lattice waves and the spin waves. A detailed analysis of the mode mixing problem in the long-wavelength limit reveals that the bulk magnons show the frozen lattice behavior, at the critical field, the value of the field necessary to flip the spins to the hard direction in the basal plane, the transverse phonon velocity, vanishes, there are a number of bulk and surface modes which degenerate into a free lattice type of uniform precession mode near the critical field, and, while it is tempting to attribute the observed "free lattice" ferromagnetic resonant absorption in the 10-GHz range to the phonon modes or the surface modes, calculations of their rates of power absorption yield values that are much too small. (auth)

13279 CALCULATION OF CONCENTRATION DEPENDENCIES OF EXCESSIVE ENTROPY AND ENTHALPY OF MIXING IN THE U–Mo SYSTEM AT 1100°K. Udovskii, A. L.; Vamberskii, Yu. V.; Ivanov, O. S. (Moscow Inst. of Metallurgy). Dokl. Akad. Nauk SSSR; 209: No. 6, 1377-1380(21 Apr 1973). (In Russian).

The excessive entropy and enthalpy (over the ideal solid solution system) of mixing were obtained for the U–Mo system at 1100°K by comparing calculated values with experimental data and thus revealing evidence of interaction of components. (KSW)

13280 THERMOEMISSIVE PROPERTIES OF SOME FACES OF A SINGLE CRYSTAL OF TUNGSTEN IN A STREAM OF SODIUM ATOMS. Imangulova, N. G.; Sytaya, E. P. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 45-48(1973). (In Russian).

Degassed W crystals were heated in an ampule with redistilled Na in a vacuum (10^{-9} torr). Emission currents of the crystal faces of W were measured with a sensitive galvanometer. The data showed that under the conditions of the experiment, the Na increased the work function of the "friable" face (111), but always lowered the work function of the "dense" face (110). A model was used to explain the behavior of Na on polycrystalline filiform samples. (KSW)

13281 MAGNETIC STRUCTURES OF $Th(Fe_{1-x}Co_x)_5$ AND Th_2Fe_{17}. Elemans, J. B. A. A. (Kamerlingh Onnes Lab., Leiden); Buschow, K. H. J. Phys. Status Solidi (b); 57: No. 2, K155-K157 (1973).

Preliminary neutron diffraction studies are reported for $Th(Fe_{1-x}Co_x)_5$ with x = 0, 0.2, 0.4, and 0.6 and Th_2Fe_{17}. The 4.2°K spectrum of $ThFe_5$ exhibits, besides the normal $CaCu_5$-type lines, additional lines indicative of antiferromagnetic ordering. With increasing Co content, the antiferromagnetic component decreases. Fe atoms displays a tendency to occupy the c site. For $x \geq 0.4$, the magnetic unit cell is identical with the chemical unit cell, and the 3d moments are parallel to the c direction. For $x < 0.4$, the main ferromagnetic component is in the basal plane.

The shortest Fe–Fe distance in $ThFe_5$ is 2.505 Å. Th_2Fe_{17} is found to be a ferromagnet with its moments in the basal plane. At room temperature, all moments are 1.1 μ_B; at 4.2°K, they are 2.9 μ_B (Th, Fe_1, and Fe_3) and 2.3 μ_B (Fe_2 and Fe_4). The shortest Fe–Fe distance in Th_2Fe_{17} is 2.384 Å. (DLC)

13282 QUADRUPOLE INTERACTION OF ^{111}Cd IN Cd METAL MEASURED WITH THE ^{111}In DECAY. Andreeff, A.; Hunger, H. J.; Unterricker, S. (Bergakademie, Freiberg Ger.). Phys. Status Solidi (b); 57: No. 2, K125-K129(1973).

Cadmium metal was bombarded by 6-MeV protons to produce ^{111}In. The quadrupole interaction between excited ^{111}Cd and the electric field gradient in Cd metal influences the angular correlation of the $\gamma-\gamma$ cascade. Measurements were made of the attenuation coefficient, frequency, and amplitude at 77 to 643°K. Results are discussed. The interaction of ^{111}Cd in Cd metal after neutron bombardment was also measured. (DLC)

13283 LIMITATIONS IN THE USE OF MORSE POTENTIALS FOR CALCULATING IDEAL STRENGTHS OF METALS. Macmillan, N. H. (RIAS, Baltimore); Kelly, A. Mater. Sci. Eng.; 12: No. 2, 79-86(Aug 1973).

A Morse potential, with values of the adjustable parameters computed by Girifalco and Weizer (Phys. Rev., 114: 687(1959)), was used to compare the binding energies of different putative forms of sixteen metals at zero temperature and pressure. All nine of the bcc metals studied, the model predicts one or other of the close-packed structures (fcc and cph) to be the stable form, and that for two of the seven fcc metals studied the model prefers the cph structure. For lead (fcc) and molybdenum (bcc) the stabilities and binding energies of the same putative forms were also investigated as a function of volume. In the former case the model predicts the observed structure to be stable over the whole range of volume investigated, while in the latter case it predicts that a linear isotropic dilation of only ~0.4% is sufficient to cause instability. It is concluded that the use of the Morse potential to calculate the ideal strength of the bcc metals is not justified, and that it offers little advantage over the Lennard-Jones potential for determination of the ideal strength of the fcc metals. (auth)

13284 EFFECT OF OXYGEN ON THE DISLOCATION STRUCTURES IN VANADIUM. Huang, Y.; Arsenault, R. J. (Univ. of Maryland, College Park). Mater. Sci. Eng.; 12: No. 2, 111-118 (Aug 1973).

A predominance of straight screw dislocations is observed in bcc metals deformed at large effective stresses, i.e. low temperatures. This observation has been used as evidence that the double kink mechanism is the rate-controlling mechanism of dislocation motion. If interstitial atoms were the short range barriers to dislocation motion, then a significant density of edge dislocation should be observed in samples deformed at large effective stresses. An investigation of vanadium containing various levels of oxygen (15 to 1000 ppM) was undertaken. The samples were deformed at small and large effective stresses in both tension and compression. One of the most significant observations was the predominance of screw dislocations in samples deformed at large effective stresses, independent of oxygen concentration. Therefore, the interstitial oxygen atoms cannot act directly as short-range barriers to dislocation motion. (auth)

13285 NMR AND NQR PROPERTIES OF LIQUID In. Halder, N. C. (Univ. of South Florida, Tampa). Phys. Status Solidi (b); 57: No. 2, 707-714(1973).

The pseudopotential method in the theory of liquid metals and the experimental atomic interference functions were used to investigate the temperature dependence of the Knight shift K_s and nuclear spin relaxation rate $1/T_1$ in liquid In. From this study, a value for the uniform exchange enhancement factor $\eta_s^{emp} = 1.65$ was predicted that agrees well with that estimated by Dupree and Seymour $\eta_s^{DS} = 1.58$. With this η_s^{emp}, K_s^{theo} were determined which are found to be in good agreement with the experimental data of Warren and Clark. These results seem to suggest that the core polarization contribution to K_s could be 25% of the direct shift and the exchange enhancement could be as large as 39% of K_s^{theo}. From the present study the magnetic and quadrupolar contributions to T_1 turn out to be $T_{1m} = 0.538$ ms and $T_{1q} = 0.960$ ms, respectively, at 170°C. (auth)

13286 ISOTOPE EFFECT OF THERMOTRANSPORT IN SOLIDS. Hensel, F.; Heitkamp, D. (Kernforschungsanlage, Juelich, Ger.). Phil. Mag.; 27: No. 5, 1245-1247(May 1973).

Barr's equation (Phil. Mag., 15: 1037(1967)) relating the steady-state distribution of an isotopic tracer to the heat of transport in a solid held in a temperature gradient is discussed in the light of recent thermotransport measurements in beryllium. (auth)

13287 STUDY OF THE POSSIBILITY OF FORMING Pu–Ga ALLOYS BY PLASTIC DEFORMATION. Hocheid, B.; Collard, J.; Boncoeur, M.; Roux, C. (Centre d'Etudes de Bruyeres le-Chatel, Montrouge, France). Mem. Sci. Rev. Met.; 69: No. 12, 919-924 (Dec 1972). (In French).

From autumn meeting on metallurgy; Paris, France (27 Sep 1971).

Tests carried out at high temperatures under vacuum on fcc Pu–6 at. % Ga alloys revealed promising possibilities for forming by plastic deformation between 20 and 200°C and 420 and 600°C. The ductility drops to zero between 380 and 400°C due to the presence of certain impurities (Fe and Ni). It does not seem likely that this parameter has very much importance for the deformation rates considered. Measurements of the work hardening coefficient and the stress sensitivity coefficient for the different deformation rates enabled the alloy to be classed with annealed aluminium and soft steel. Experimental tests confirmed these results. Similar conclusions can be drawn for the Pu–2 at. % Ga alloy. (FR)

13288 SOLUBILITY OF VANADIUM AND TUNGSTEN IN α AND γ PHASES IN THE Fe–V AND Fe–W BINARY SYSTEMS. Kovacova, K.; Kralik, F. (Ustav Kovovych Materialov, Bratislava). Kovove Mater.; 11: No. 2, 93-97(1973). (In Slovak).

The solubility of vanadium and tungsten was determined in the temperature range from 911 to 1390°C. The maximum solubility of vanadium is found to be 1.8 and 1.39 at. % in alpha and gamma solid solutions, respectively, in the Fe–V system, while the maximum solubility of tungsten is found to be 2.0 and 1.44 at. % in the alpha and gamma phases, respectively, in the Fe–W system at 1150°C. (IAA)

13289 ELECTRONIC STRUCTURE OF V_3Ga. Bondarenko, T. N.; Dzeganovskii, V. P.; Zhurakovskii, E. A. (Inst. of Problems in Materials Science, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 4, 683-685(Apr 1973). (In Russian).

X-ray spectra of V_3Ga, pure Ge, and Ge in V_3Ge were determined and the data were treated by the method of L. F. Mattheiss (1965). The energy scheme of V_3Ga, valence zones, p-states, d-states, and electron structure of V_3Ga are discussed and compared with V_3Si and V_3Ge. (KSW)

13290 AGING OF DEFORMED LOW-ALLOYED MOLYBDENUM. Danyushchenkov, I. A.; Kaverina, S. N.; Lizunov, V. A.; Minakov, V. N.; Trefilov, V. I. Fiz. Khim. Obrab. Mater.; No. 5, 41-46(1972). (In Russian).

The processes of aging deformed Mo (0.1% Zr, 0.05% La) (total reduction by rolling >80%) which had been given a 30-min annealing at 1100°C were studied. The influence of the limits of the porous structure on the release of particles of the second phase and their distribution in the matrix subsequent to various annealing histories was investigated. The change in mechanical properties was correlated with the change in the length of the slip bands, limited by the distance between boundaries. The effect of particles of the second phase was manifest in the retardation of the processes of collective recrystallization in the porous structure. (tr-auth)

13291 EFFECT OF RATE OF CYCLIC STRESSING ON FATIGUE OF SOME PURE METALS AT NORMAL TEMPERATURES. Shibarov, V. V.; Shetulov, D. I.; Myasnikov, A. M.; Sokolov, L. D. Fiz. Khim. Obrab. Mater.; No. 5, 74-77(1972). (In Russian).

A linear dependence of fatigue strength on the frequency of loading was observed in samples of very pure In, Ga, Bi, Cd, and La over the frequency range from 2 to 6000 min^{-1}. The effects observed were associated with adiabatic heating of the samples, heat conductivity of the metal, the accumulated deformation, and velocity effects. (KSW)

13292 FRACTOGRAPHIC ANALYSIS OF A FORM OF HOT CRACKING IN WELDED SEAMS OF NICKEL ALLOYS. Bulatov, Yu. V.; Erokhin, A. A.; Loseva, G. I. Fiz. Khim. Obrab. Mater.; No. 5, 95-100(1972). (In Russian).

Welded seams were studied in two Ni alloys: Ni–21% Cr (with traces of Mn, Ti, Si, Al, C), and Ni–10% Nb–5% Al (with traces of Ti, Fe, C). Fractographic analysis was an aid to evaluation of the state of the metal at the moment of hot-crack formation in the welded seams. The Ni–Cr alloy was typified by hot cracking in the solid–liquid state. In the Ni–Nb–Al alloy, cracks were generated in the solid state. (tr-auth)

13293 INFLUENCE OF COMPOSITION ON STRENGTH OF MAGNESIUM–NEODYMIUM ALLOY BY THE HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT METHOD. Oreshkina, A. A. Fiz. Khim. Obrab. Mater.; No. 5, 144-146(1972). (In Russian).

The effect of the Nd content on the mechanical properties and structure of Mg–Nd alloys was investigated after subjecting them to high-temperature thermomechanical processing. A comparison with the usual T6 thermal treatment showed that in both cases the optimum Nd content in the alloys was 3 to 3.4%, which in turn corresponded to the solubility of Nd in Mg at the quenching temperature. A Nd content >3.4% caused a significant change in the me-

chanical properties and the specific electrical resistance which was associated with an excess of the Mg_3Nd phase. (KSW)

13294 HIGH-TEMPERATURE THERMODYNAMIC INVESTIGATION OF THE Nb–Mo SYSTEM. Singhal, S. C.; Worrell, W. L. (Univ. of Pennsylvania, Philadelphia). Met. Trans.; 4: No. 4, 1125-1128(Apr 1973).

The thermodynamic properties of solid Nb–Mo alloys were determined between 1050 and 1300°K using solid-state galvanic cells with a thoria-based electrolyte. The activities of niobium and molybdenum exhibit negative deviations from Raoult's law. The excess entropies of mixing are very small and negative, and the excess integral free energies of mixing are almost equal to the integral enthalpies of mixing. The negative entropies of mixing are attributed to a negative vibrational contribution and/or short-range ordering. (auth)

13295 EXPERIMENTAL AND THERMODYNAMIC STUDY OF THE EQUILIBRIA BETWEEN FERRITE, AUSTENITE, AND INTERMEDIATE PHASES IN THE Fe–Mo, Fe–W, AND Fe–Mo–W SYSTEMS. Kirchner, G.; Harvig, H.; Uhrenius, B. (Royal Inst. of Tech., Stockholm). Met. Trans.; 4: No. 4, 1059-1067(Apr 1973).

The phase equilibria between ferrite and austenite and between ferrite and the intermediate R- and μ-phases have been studied by subjecting high-purity alloys of Fe–Mo, Fe–W, and Fe–Mo–W to well-controlled heat treatments. The equilibrium compositions at the two-phase interfaces were measured with an electron microprobe. Some of the experimental results show reasonable agreement with previously reported values, but are believed to be of higher accuracy. The new experimental data were, together with available relevant thermodynamic information, evaluated in terms of mathematical models for the individual phases and the parameters thus obtained were then used to calculate the two-phase boundaries in the binary Fe–Mo, Fe–W, and ternary Fe–Mo–W systems. In the course of this study the free energy of formation of the R and μ phases was also evaluated. (auth)

13296 THERMODYNAMICS OF FORMATION OF Th–Fe ALLOYS. Skelton, W. H.; Magnani, N. J.; Smith, J. F. (Iowa State Univ., Ames). Met. Trans.; 4: No. 4, 917-920(Apr 1973).

Electromotive force cells were used to determine the Gibbs free energies, enthalpies, and entropies of formation for Th_2Fe_{17}, $ThFe_2$, Th_2Fe_7, $ThFe_3$, and Th_7Fe_3 over the temperature range 928 to 1164°K. Solid CaF_2 was used as the electrolyte. Comparisons of Th–Fe, Th–Co, and Th–Ni thermodynamic data show patterns that correlate with crystallographic and magnetic behavior. Some inferences are drawn about the bonding interactions within the phases in these alloy systems. (auth)

13297 MARTENSITIC TRANSFORMATIONS IN β Ag–Cd ALLOYS. Krishnan, R. V.; Brown, L. C. (Univ. of British Columbia, Vancouver). Met. Trans.; 4: No. 4, 1017-1022 (Apr 1973).

Phase transformations were studied in β Ag–Cd alloys lying in the composition range 42.3 to 50.9 at. % Cd. Thermal martensite with an orthorhombic structure was obtained on cooling below room temperature. The M_s temperature was found to change from −44 to −137°C as the cadmium content changed from 44.2 at. % to 47.0 at. %. The martensite had a habit plane close to $(133)_\beta$ in good agreement with that calculated from the phenomenological theory assuming a $(011)[0\bar{1}1]_\beta$ lattice-invariant shear. An fct martensite was obtained on moderate degrees of deformation at room temperature. This had a habit plane close to $(110)_\beta$, again in good agreement with the phenomenological theory assuming a $(110)[1\bar{1}0]_\beta$ lattice-invariant shear. On severe deformation a close-packed structure was obtained, this being fcc up to 45.5 at. % Cd, hcp above 47.7 at. % Cd, and a mixture of both fcc and hcp at 46.0 at. % Cd. A spontaneous martensite with an fcc structure was found to occur along the thin edges of perforated specimens used for electron microscopy. A mechanism suggesting the course of the transformation has been proposed. (auth)

13298 TWINNING IN NIOBIUM: A CONTINUOUS NUCLEATION THEORY. Shaw, B. J. (Westinghouse Research and Development, Pittsburgh). Met. Trans.; 4: No. 4, 1003-1009 (Apr 1973).

The energy required to form a twin in niobium was experimentally determined to be of the order 10^9 erg/cm^3. This high energy is explained in terms of a continuous nucleation theory that also accounts for the observed morphology of twins in bcc transition metals and the heat evolved in the process. (auth)

13299 MEASUREMENT OF VAPOR PRESSURE OF INDIUM OVER α Ag–In USING ATOMIC ABSORPTION. Masson, D. B.; Pradhan, S. S. (Washington State Univ., Pullman). Met. Trans.; 4: No. 4, 991-995(Apr 1973).

The vapor pressure of indium over seven binary alloys of the α Ag–In system was measured by atomic absorption. Thermodynamic activity, relative partial molal enthalpy, and partial entropy of indium were calculated from the vapor pressures and their temperature coefficients. The results were used to evaluate an equation derived previously from the rigid band model, giving the composition dependence of the activity coefficient of solutes in terminal solutions to which the Hume-Rothery electron/atom (e/a) correlations apply. This treatment ascribes the nonideal behavior of alloy components to electronic factors. The observed behavior is consistent with the linear dependence of $\ln \gamma_{solute}$ on atom fraction predicted by the model; the observed dependence of $d \ln \gamma_{solute} / dX_{solute}$ on solute valence also substantiates the model. The results are believed to be the first measurement of the activity of a trivalent solute in solid alloys of copper, silver or gold of the type treated by the e/a correlations. Atomic absorption was found to be suitable for the measurement of vapor pressure of indium, although the reliability of the temperature coefficients was not high because of the restricted temperature range covered. (auth)

13300 STRENGTH DIFFERENTIAL EFFECT IN α–Pu. Merz, M. D. (Battelle Northwest Labs., Richland, WA). Met. Trans.; 4: No. 4, 1186-1188(Apr 1973).

A very large strength differential effect (SD) in α–Pu is examined. Results of analyses of twinning and pressure-dependent diffusion-controlled creep indicate that either can account for the large magnitude of the SD effect in α–Pu. A diffusion-controlled model is probably applicable since creep of α–Pu does appear to be diffusion controlled in this stress range and no twins were observed. However, since the mechanisms of plastic deformation in α–Pu are not completely understood, further microstructural and phenomenological observations of creep are necessary to resolve this question. Clearly, the relation of the structural changes during deformation to flow stress is not yet understood. The SD effect in α–Pu is larger than that in any other metal, and this warrants further study. (JRD)

13301 HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF SOLID Ta–W ALLOYS. Singhal, S. C.; Worrell, W. L. (Univ. of Pennsylvania, Philadelphia). Met. Trans.; 4: No. 4, 895-898(Apr 1973).

The partial molar and integral molar thermodynamic properties of solid Ta–W alloys were determined between 1050 and 1300°K using galvanic cells with a thoria-based electrolyte. The activities in this system exhibit negative deviations from ideality, but the magnitude of the negative deviation is less than that observed previously for the Ta–Mo alloys. The negative excess free energies of mixing are due mainly to the enthalpies of mixing. The observed small negative excess entropies of mixing can be attributed to vibrational contributions and/or short range ordering in these alloys. (auth)

13302 STRUCTURAL, MAGNETIC, AND NEUTRON DIFFRACTION STUDIES ON $TbFe_2$–$TbAl_2$, $TbCo_2$–$TbAl_2$, AND $HoCo_2$–$HoAl_2$. Oesterreicher, H. (Oregon Graduate Center, Beaverton). J. Phys. Chem. Solids; 34: No. 7, 1267-1280(Jul 1973).

Both pseudobinary systems exhibit large homogeneous regions of cubic and hexagonal Laves phases. Ordering tendencies on crystallographic sites between Al and the transition metals are observed in the hexagonal type. Electron transfer to the transition metals quenches their moments so that they become non-magnetic at high Al concentrations. The peculiarities in the mechanism of magnetization which appear in rare earth dialuminides when Al is replaced by a transition metal have been studied in detail at cryogenic temperatures. The first replacement of Al results in a decrease in saturation moment. Neutron diffraction verifies the low-ordered rare earth sublattice moments and reveals the "lost part" as a disordered component. Considerable magnetic hardness develops in certain regions of concentration often connected with spontaneous increases in magnetization with field. All available evidence suggests the presence of unusual domain wall effects to be responsible for this effect. High remanences develop in both the hexagonal and in the cubic structures in the intermediate region. The development of disordered magnetic components is connected either with the disorder on crystallographic sites or changes in the free electron concentration. (auth)

13303 MECHANISM AND KINETICS OF FIRST STAGE OF DECOMPOSITION OF MARTENSITE DURING TEMPERING OF QUENCHED RHENIUM STEELS. Lysak, L. I.; Andrushchik, L. O. (Inst. of Metal Physics, Kiev). Metallofizika; 33: 69-73(1971). (In Russian).

The disintegration of martensite steel alloyed with Re (3 to 20%) was studied. The first stage with material containing from 0.8 to 1.4% C and 20 to 10% Re was two-phase, and for that containing 1.6 to 1.7% C and from 8 to 6% Re the first stage was three-phase.

An increase in the concentrations of C and Re in the steels reduced the rate of the initial decay step. For an increase in the C concentration in steel, the ratio c/a of the tetragonal lattice of $\varkappa$-martensite increased. (KSW)

13304 ALLOYS OF CHROMIUM WITH TERBIUM. Svechnikov, V. N.; Kobzenko, G. F.; Ivanchenko, V. G. (Inst. of Metal Physics, Kiev). Metallofizika; 33: 93-95(1971). (In Russian).

The complete composition range of Cr–Tb alloys was investigated by differential thermal, metallographic, and x-ray analyses, and the phase diagram was constructed. Depending on the composition and temperature, Cr–Tb alloys may undergo three nonvariant transformations at the temperatures 1775, 1165, and 1045°C. Between 10 and 40% Tb, the alloys crystallized with the formation of nonhomogeneous structures, interpreted as an immiscibility in the liquid phase. (KSW)

13305 SOLUBILITY OF CERIUM, PRASEODYMIUM, AND NEODYMIUM IN CHROMIUM CONTAINING OXYGEN. Kobzenko, G. F.; Kholodov, A. G.; Ivanchenko, V. G.; Martynchuk, E. L.; Kashevskaya, O. N. (Inst. of Metal Physics, Kiev). Metallofizika; 33: 95-99(1971). (In Russian).

The solubilities of Ce, Pr, and Nd in Cr were determined over the temperature range 1000 to 1810°C. The original Cr contained 0.003 wt % oxygen, 0.005 wt % N, and 0.004 wt % C. The microhardness of α-Cr was measured as a function of the atom % Nd up to 5.0 at. %. (KSW)

13306 STRUCTURE, PHASE COMPOSITION, AND SOME PROPERTIES OF CAST COMPLEX Ni-BASE ALLOYS WITH Nb. Belinskaya, L. A.; Braun, M. P.; Ionkina, E. M.; Lebedev, K. P.; Khil'chevskaya, T. V. (Inst. of Foundry Problems, Kiev). Metallofizika; 33: 102-107(1971). (In Russian).

The influence of Nb (about 7%), Mo (5 to 10%) and W (3%) on the properties and structure of cast Ni alloys containing 15% Cr and 8% Nb was studied. The presence of Ni_3Nb tended to strengthen the alloys, separating out from a supersaturated solution. The Mo and W had an additional toughening effect. (KSW)

13307 SYSTEM NIOBIUM–ALUMINUM–GERMANIUM: PHASE DIAGRAM AND SUPERCONDUCTIVE PROPERTIES. Pan, V. M.; Latysheva, V. I. (Inst. of Metal Physics, Kiev). Metallofizika; 33: 38-50(1971). (In Russian).

This survey paper presents various aspects of the phase composition diagram of the ternary system Nb–Al–Ge for the temperature range 1000 to 2000°C. A four-phase peritectic equilibrium $L + \beta \rightleftharpoons \alpha + \sigma$ was established, with considerable dissolution of Ge in the β and σ phases. A continuous series of solid solutions between the isomorphic compounds β-Nb_3Al and β-Nb_3Ge was observed, with preservation of the stoichiometry of $Nb_3Al_xGe_{1-x}$ up to $Nb_3Al_{0.8}Ge_{0.2}$ and $Nb_3Al_{0.7}Ge_{0.3}$. As Ge replaced Al in this series, T_c increased as long as the stoichiometry was preserved; this phenomenon was associated with ordering as a result of the disintegration of a metastable compound of the stoichiometric composition. (41 references) (tr-auth)

13308 DECOMPOSITION OF SUPERSATURATED SOLID SOLUTIONS ACCORDING TO A HETEROGENEOUS MECHANISM. Larikov, L. N.; Shmatko, O. A. (Inst. of Metal Physics, Kiev). Metallofizika; 33: 5-37(1971). (In Russian).

The changes in a series of properties of aging alloys were studied as a function of the mechanism of separation. The contemporary representation of formation and growth of centers of a new phase during heterogeneous disintegration was considered. Classification of aging alloys, and the supersaturation of alloys in which the decay of supersaturated solid solutions by a heterogeneous mechanism are discussed. The example of the alloy Co–31.89% W is referred to extensively in the paper. (301 references) (KSW)

13309 CALORIMETRIC MEASUREMENT OF THE HEAT OF DISSOLUTION OF EUROPIUM IN TIN. Determination of the Enthalpy of Formation of the Defined Compound $EuSn_3$. Bacha, A. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France); Chatillon Colinet, C.; Percheron, A.; Mathieu, J. C.; Achard, J. C. Compt. Rend., Ser. C; 276: No. 12, 995-998(19 Mar 1973). (In French).

The heat of dissolution of europium in tin was measured at 957K. This measurement enabled the partial enthalpy of europium to be determined at 957K (−42.61 kcal. at. g^{-1}). The heat of dissolution of the $EuSn_3$ compound was measured. The enthalpy of formation of this compound was determined at 295.7K (−50.48 kcal. $mole^{-1}$), using this value and taking into account the heat of dissolution of europium. (FR)

13310 OBSERVABILITY OF NO NMR ON A PARAMAGNETIC IMPURITY IN A DIAMAGNETIC METAL. Spanjaard, D.; Hartmann Boutron, F. (Paris Univ., Orsay, France). J. Phys., F (London); 3: No. 6, 1178-1192(Jun 1973).

It is shown that the observation of nuclear magnetic resonance detected by nuclear orientation technique (NO NMR) should be rather difficult for a radioactive nucleus belonging to a paramagnetic impurity in a metal. This arises both from the broadening of the NMR lines through electronic relaxation and also, when the electronic relaxation is slow, from the splitting of the resonance line due to the second-order effects of the off-diagonal elements of the hyperfine interaction. (auth)

13311 SPECIFIC HEAT AND SUPERCONDUCTIVITY OF Th–Y AND Th–La ALLOYS. Satoh, T.; Kumagai, K. I. (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 34: No. 2, 391-395(Feb 1973).

The low-temperature specific heats of Th–Y and Th–La alloys were measured in order to compare with that of La–Y alloys. The change of the Debye temperature of Th–Y alloys with Y concentration is very similar to that of La–Y alloys. The atomic property of McMillan–Hopefield's parameter η is also discussed. (auth)

13312 HEAT CAPACITY AND TRANSFORMATIONS IN α URANIUM AT LOW TEMPERATURE. Crangle, J.; Temporal, J. (Sheffield Univ., Eng.). J. Phys., F (London); 3: No. 6, 1097-1105(Jun 1973).

The heat capacities of two polycrystalline specimens and of one pseudosingle crystal of α uranium were measured between 2 and 70K. An anomaly of uncertain origin appears in all the samples at 43K. If it is tentatively ascribed to a magnetically ordered state, the mean magnetic moment per atom is about $6 \times 10^{-2}\ \mu_B$. Only pseudosingle crystal shows additional, apparently first-order, effects at 22K and 37K. (auth)

13313 PARAMAGNETIC RESONANCE OF Gd^{3+} IN THE INTERMETALLIC COMPOUND $LaAl_2$. Taylor, R. H. (Imperial Coll. of Science and Tech., London). J. Phys., F (London); 3: No. 6, L110-L114(Jun 1973).

The g shift and line width of Gd in a series of alloys of the form $(La_{1-x}Gd_x)Al_2$ were studied as a function of temperature. At the lowest concentrations ($x < 0.0025$) a large positive g shift to $+0.063 \pm 0.01$ was observed, but as the concentration is increased, the system becomes progressively bottlenecked. No signs of dynamic effects in the EPR bottleneck were observed. At high concentrations ($x > 0.05$) the effects of magnetic ordering in the system are clearly shown. (auth)

13314 ELECTRICAL RESISTANCE NEAR THE ANTIFERROMAGNETIC TRANSITION OF DYSPROSIUM. Rao, K. V.; Rapp, O.; Richard, T. G.; Geldart, D. J. W. (Kungliga Tekniska Hoegskolan, Stockholm). J. Phys., C (London); 6: No. 11, L231-L234(11 Jun 1973).

The electrical resistance R(T) of a c-axis single crystal of dysprosium was measured in the vicinity of the Néel point T_N using a high-precision (8-digit resolution) direct-current comparator method. Numerical analysis of the data yields a power law of the form $R(T) = A + B\epsilon + C\epsilon^{\psi}$ in the range $2.5 \lesssim T - T_N \lesssim 60$ K, where $A, B > 0$, $C < 0$ and $\psi = 0.60$. This power law does not extend into the region $0 \lesssim T - T_N \lesssim 2.5$K. The breakdown of the power law is consistent with the view that long-range spin fluctuations fail to dominate scattering processes in the immediate vicinity of the Néel point of helical antiferromagnets. (auth)

Radiation Effects

Refer also to abstracts 13367, 14204, 14418, and 14427.

13315 (AD-753457) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, 1 August–31 October 1972. Steele, L. E. (Naval Research Lab., Washington, D. C.). 15 Nov 1972. Contract AT(49-5)-2110. 50p. (NRL-MR-2531). NTIS.

The research program of the NRL Metallurgy Division, Reactor Materials Branch, involves a broad study of the effects of nuclear radiation upon materials. The report includes: J-integral characterization of irradiated 304 stainless steel; studies of fatigue crack propagation in neutron-irradiated stainless steel weldments; exploratory assessments of A508 forging radiation resistance; a parametric study of vacancy trapping during irradiation; and surveillance results for the MH-1A reactor pressure vessel. (auth)

13316 (EUR–4820(Vol. 6)(Pt. L), pp 587-603) EFFECT OF NUCLEAR RADIATION ON FAST-FRACTURE BEHAVIOUR OF METALS. Irvine, W. H. (United Kingdom Atomic Energy Authority, Risley, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A stress-concentration approach to fracture mechanics that has been developed in the UKAEA is described briefly. By con-

sidering the equilibrium of the section along the axis of the crack, the load that would have been carried by the cracked material can be equated to the extra load carried by the high-stress regions at the crack tips, and thus to the size of this region and its stress level at failure. This theory is extended to cover cylindrical pressure components and is used to describe the overall effect of the changes mentioned above. It shows that these changes may either increase or decrease the critical crack size, depending on the level of stress in the component. Using experimental data for the bursting strengths of irradiated and unirradiated Zr–Nb pressure tubes containing artificial flaws, in conjunction with material properties relevant to these materials, it is shown that a reasonably accurate prediction of the fast-fracture behaviour of the irradiated tube can be made. (LMT)

13317 AUTOMATED METHOD FOR CALCULATING ENERGY DEPOSITION IN CTR MATERIALS. Rigdon, L. D. (Naval Weapons Evaluation Facility, Kirtland AFB, NM); Sandmeier, H. A.; Hansen, G. E. Trans. Amer. Nucl. Soc.; 16: 5-6(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13318 LIBRARY OF MULTIGROUP KERMA FACTORS AND PARTIAL CROSS SECTIONS FOR FUSION NEUTRONICS AND PHOTONICS. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 6-7(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13319 SOLUTE SEGREGATION TO VOIDS DURING ELECTRON IRRADIATION. Okamoto, P. R. (Argonne National Lab., IL); Harkness, S. D.; Laidler, J. J. Trans. Amer. Nucl. Soc.; 16: 70(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13320 EFFECT OF BEAM SCANNING ON NICKEL-ION DAMAGE IN NICKEL. Sprague, J. A.; Westmoreland, J. E.; Smidt, F. A. Jr.; Malmberg, P. R. (Naval Research Lab., Washington, DC). Trans. Amer. Nucl. Soc.; 16: 70-71(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13321 MICROSTRUCTURAL EFFECTS OF IMPLANTED HELIUM ON FATIGUE OF 316 STAINLESS STEEL. Serpan, C. Z. Jr.; Michel, D. J.; Smith, H. H.; Pieper, A. G. (Naval Research Lab., Washington, DC). Trans. Amer. Nucl. Soc.; 16: 71-73(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13322 EFFECTS OF TEMPERATURE AND TEMPERATURE GRADIENTS ON THE MOVEMENT OF HELIUM IN PURE ALUMINUM MATRICES. Perazza, M. R. (Univ. of Puerto Rico, Mayaguez); Davis, M. V. Trans. Amer. Nucl. Soc.; 16: 73 (Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13323 SOME IMPLICATIONS OF FAST- VS THERMAL NEUTRON IRRADIATION OF METALS. Horak, J. A.; Blewitt, T. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 73-74(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13324 THEORETICAL ANALYSIS OF INTERACTIONS AMONG DIFFUSING DEFECTS DURING IRRADIATION. Howe, T. M.; Schiffgens, J. O. (Purdue Univ., Lafayette, IN). Trans. Amer. Nucl. Soc.; 16: 74-75(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13325 TEAR FORMATION AND GROWTH IN IRRADIATED α URANIUM. Lee, K. A.; Wazzan, A. R.; Okrent, D. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 16: 79-80 (Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13326 PROBABILISTIC FORMULATION OF FISSION GAS RELEASE IN URANIUM ALLOY FUELS. Sun, Y.; Okrent, D.; Wazzan, A. R. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 16: 81-82(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13327 APPLICATION OF $^{3}He(dp)^{4}He$ REACTION TO DETERMINE He DISTRIBUTION PROFILES IN ION BOMBARDMENT STUDIES OF REACTOR STRUCTURAL MATERIALS. Taylor, A.; Klippert, T. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 82-83(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13328 EFFECT OF IRRADIATION TEMPERATURE ON VOID FORMATION IN COLD-WORKED TYPE 316 STAINLESS STEEL. Brager, H. R.; Straalsund, J. L. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 94-95(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13329 MEASUREMENTS OF THE EFFECTS OF SWELLING ON THE YOUNG'S MODULUS OF STAINLESS STEELS. Marlowe, M. O. (General Electric Co., Pleasanton, CA); Appleby, W. K. Trans. Amer. Nucl. Soc.; 16: 95-96(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13330 AUGER SPECTROSCOPY OF FRACTURE SURFACES OF IRRADIATED STAINLESS STEEL. Bloom, E. E.; Clausing, R. E.; McGuire, G. E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 96-97(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13331 THRESHOLD TEMPERATURE FOR VOID FORMATION IN THE GROUP VIa METALS. Sikka, V. K.; Moteff, J. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 16: 97(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13332 IRRADIATION TEMPERATURE MONITORING BY VOID SUPERLATTICE CONSTANT MEASUREMENTS. Moteff, J.; Sikka, V. K. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 16: 97-98(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13333 IN-REACTOR ELONGATION OF ZIRCONIUM ALLOY PRESSURE TUBES. Ross-Ross, P. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 16: 99-100 (Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13334 EFFECTS OF LOW-ENERGY PROTON RADIATION DAMAGE ON THE TCR OF REACTIVELY SPUTTERED Ta THIN-FILM RESISTORS. Hardy, W. R.; Shewchun, J. (McMaster Univ., Hamilton, Ont.). Radiat. Eff.; 17: No. 3-4, 143-149(1973).
Tantalum thin-film resistors reactively sputtered in oxygen and nitrogen simultaneously were irradiated with 150-keV protons. The TCR (temperature coefficient of resistance) of these discontinuous films, consisting of interconnected metallic islands largely surrounded by Ta_2O_5, may be considered to be composed of two components: a negative component due to activated tunneling between islands, and a positive component due to metallic conduction. The observed negative increase in room temperature (30 to 100°C) TCR with fluence is attributed to an increase in the proportion of the tunneling component relative to the metallic component as the result of an enhanced tunneling mechanism which is due to radiation-produced defects within the inter-island oxide regions. Following irradiation at 30°K, the low temperature (–240 to –229°C) TCR recovers rapidly with annealing temperature up to 150°K. Between 150 and 300°K, relatively little TCR recovery occurs. The TCR recovery is attributed to the annihilation of radiation-produced defects within both island and gap regions of the films. (auth)

13335 THERMOKINETIC ANALYSIS FOR RELEASE OF HELIUM FROM IRRADIATED MATERIALS. Karasev, V. S.; Kislik, V. S.; Shved, G. F.; Grebennikov, R. V. At. Energ. (USSR); 34: No. 4, 251-254(Apr 1973). (In Russian).
A method is described for the kinetic investigation of the release of helium, formed as the result of nuclear reactions, from samples of reactor structural materials. The method is based on the mass-spectrometric measurement of the flow of helium, proportional to the rate of its release from irradiated samples subjected to linear heating in vacuum. The sensitivity and reproducibility of measurements are presented. For various materials (austenitic steel, dispersion of boron carbide in aluminum and graphite), it was shown that temperature–velocity curves of the release of helium from samples have a number of maxima, characterizing the existence of various mechanisms of diffusive release of helium. The use of models for the interaction of point defects with impurities helped to clarify the relationship between experimental characteristics and parameters of helium diffusion (activation energy, frequency factor). For the aforementioned materials, there was established a linear dependence between values of activation energy and characteristic temperature for

various stages of helium release. (4 figures, 17 references). (auth)

13336 EFFECT OF INDIUM BURNUP ON THE MELTING TEMPERATURE OF GAMMA CARRIERS OF RADIATION LOOPS. Zakharov, D. M.; Kiknadze, G. I.; Lyudvigov, R. B. At. Energ. (USSR); 34: No. 4, 289-290(Apr 1973). (In Russian).

In γ-carriers composed of In–Ga or In–Ga–Sn alloys, the (n,γ) reaction with ^{115}In gradually leads to a "burnup" of In, and a build-up of the stable isotope ^{116}Sn. The result involves a departure from the initial composition and its melting point. The change in melting point of the eutectic (Ga–20.5 wt % In–12.5 wt % Sn) with increasing Sn content was determined: The fusion point rose from ~10°C to ~58°C as the Sn content increased from 12.5% to 27%. The kinetics of this conversion are discussed. (KSW)

13337 RECOVERY OF COPPER ALLOYS AFTER NEUTRON IRRADIATION AT LOW TEMPERATURES. Takamura, S.; Okuda, S. (Japan Atomic Energy Research Inst., Tokai). Radiat. Eff.; 17: No. 3-4, 151-158(1973).

The effects of fast-neutron irradiation near 4.2°K on dilute Cu, Cu_3Au, α-CuZn, β-CuZn, and CuNi alloys were studied by electrical resistivity measurements. For Cu_3Au, the recovery stage at ~100°K becomes more distinct with increasing long-range order, and is attributed to migration of interstitials. The ratio of the number of replacements to the number of displacements (C_R/C_F) is estimated to be about 50 for neutron irradiation, in contrast to the previously reported value of ~2 for electron irradiation. For α-CuZn, a large recovery stage at ~150°K is found and attributed to annihilation of interstitials whose migration produces ordering. For β-CuZn, migration of interstitials also produces ordering. It is also suggested that in β-CuZn, the ratio C_R/C_F is larger for neutron irradiation than for electron irradiation as in the case of Cu_3Au. The results on CuNi alloys are presented without explanation. (auth)

13338 EFFECT OF ENERGETIC IRRADIATION ON MECHANICAL PROPERTIES OF METALS. Rykalin, N. N.; Bystrov, L. N.; Ivanov, L. I. (Inst. of Metallurgy, Moscow). Radiat. Eff.; 17: No. 3-4, 241-244(1973).

The effect of processes caused by radiation-enhanced diffusion on mechanical properties of metals is discussed. Experimental results of electron irradiation (E = 2.3 MeV) of the alloys Fe–Cr (15 and 20% Cr), Fe–5% Mo, Cu–2.5% Be, and cold-worked Ni are given. Irradiation temperature was in the range 20 to 200°C; irradiation doses in the range up to 5×10^{18} cm^{-2}. It was found that irradiation decreases ultimate tensile strength σ (7 to 8% for Fe–20% Cr) and elongation δ (25 to 15% for Fe + 20% Cr) and increases yield strength $\sigma_{0.2}$ (25% for Fe + 20% Cr). This effect is explained by precipitation of σ-phase in Fe–Cr alloys caused by diffusion. Smaller value of radiation effect in the alloy Fe + 15% Cr in comparison with the alloy Fe + 20% Cr and x-ray structural analysis confirm this conclusion. Mechanical properties of the alloy Fe–Mo change due to irradiation similarly. These changes are connected with precipitation of ϵ-phase. Irradiation of the alloy Cu–2.5% Be quenched from 800°C changes its mechanical properties to a large extent. Yield strength increases 3 to 4 times, elongation decreases from 30 to 12%. This effect is stimulated by precipitation of strengthening γ-phase due to radiation-enhanced diffusion. Irradiation of cold-worked Ni specimens decreases the yield strength. This may be the result of motion and partial annihilation of dislocations. (auth)

13339 NOTE ON THE OPTICAL PROPERTIES OF SPUTTERED GOLD FILMS. Chadderton, L. T.; Johansen, A.; Steenstrup, S.; Sarholt-Kristensen, L. (Univ. of Copenhagen). Radiat. Eff.; 17: No. 3-4, 281-283(1973).

Curves are presented of microdensitometer response (intensity vs angular distribution) for sputtering from {110} single-crystal and polycrystalline gold, using 80-keV argon ions. Structure appears in the trace of the [011] peak for the single crystal. The possible interpretation of this structure is discussed, after considering the optical properties of the photodiode and the granularity of the sputtered film as revealed by electron micrographs. The absence of structure in the [110] and [10$\bar{1}$] peaks and in the "random" patterns can be attributed to a smaller change in granularity in these regions than in the central [011] peak. From the optical properties of the photodiode, it can be ascertained that the film granularity for the [110], [10$\bar{1}$], peaks and for "random" stays below q, (the volume factor) ~0.95 while for the [011] peak the granularity changes from $q \approx 0.95$ to $q > 0.95$. It is concluded that the structure in the [011] peak is an artefact in the sense that it is not a structure in thickness but in granularity. (UK)

13340 SECONDARY ELECTRON EMISSION OF SINGLE CRYSTALS OF GERMANIUM BOMBARDED WITH RUBIDIUM IONS. Kasymov, A. Kh.; Normuradov, M. (Tashkent Polytechnic Inst.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 41-44(1973). (In Russian).

The effect of prior bombardment of single crystals of p-type Ge (with a specific resistance of 30 ohm·cm) with 0.6- to 8-keV Rb^+ ions was studied. The secondary electron emission coefficient as a function of primary electron energy over the range 100 to 2000 eV is shown for 5 different Rb ion energies. Likewise, the inelastic reflection coefficient as a function of the same primary electron energies is shown for 4 different Rb ion energies. (KSW)

13341 RADIATION DAMAGE IN ALUMINUM IRRADIATED BY LOW-ENERGY PROTONS. Bondarenko, G. G.; Ivanov, L. I. Fiz. Khim. Obrab. Mater.; No. 5, 15-18(1972). (In Russian).

Electropolished samples of polycrystalline aluminum (99.99%) were irradiated with 140-keV protons at room temperature for doses of 3×10^{16} to 1.5×10^{17} protons/cm^2. The electron microscope revealed radiation damage in the form of dislocated loops and bubbles, both tending to block movement of dislocations in the irradiated aluminum. (KSW)

13342 QUESTION OF DIVACANCIES IN GERMANIUM. Morrison, S. R.; Newman, R. C. (Univ. of Reading, Eng.). J. Phys., C (London); 6: No. 11, 1981-1988(11 Jun 1973).

Infrared-absorption measurements were made on germanium crystals irradiated by 2-MeV electrons at 110K. All samples showed near-edge absorption, while certain crystals also showed an electronic absorption band at 2.40 μm. These observations are similar to previous measurements made on ion-bombarded germanium. Attempts to modify the strength of the 2.40-μm band by irradiating crystals containing either oxygen or silicon impurities were unsuccessful. Although the absorption features show similarities to those arising from divacancy centers in silicon, the evidence for divacancies in germanium is still considered to be inconclusive. (auth)

13343 CREATION AND ELIMINATION OF POINT DEFECTS IN ZIRCONIUM IRRADIATED AT 24°K. Vialaret, P.; Moreau, F.; Bessis, A.; Demitrov, C. (Centre National de la Recherche Scientifique, Vitry-sur Seine, France). Compt. Rend., Ser. C; 27: No. 15, 1255-1258(9 Apr 1973). (In French).

The presence of oxygen increases the extent to which zirconium is damaged by neutron irradiation. Studies on the annealing of the defects produced demonstrate the existence of five stages in the recovery between 24 and 350°K. A model is proposed that explains the phenomena observed. (FR)

13344 TRANSMISSION ELECTRON MICROSCOPY AT 2.5 MeV. Thomas, G. (Univ. of California, Berkeley); Lacaze, J. C. J. Microscopy; 97: No. 3, 301-308(Apr 1973).

Measurements of penetration on silicon and austenitic stainless steel have been continued using the same criteria as previously reported (Thomas, Phil. Mag.; 17: 1097 (1968)) up to 2.5 MeV using the 3-MeV Toulouse electron microscope. The results show that penetration increases to about 14 μm at 2.5 MeV for silicon although the curve starts to flatten out above 1.5 MeV, but no significant gain was found for stainless steel $\simeq 2\mu$m at 2.5 MeV. Primary knock-on damage occurs readily in both materials. The critical voltages for 440 silicon and 422 tantalum were measured, and both found to be 1.4 MeV (±10 kV). Attempts to measure the variation of radiation damage with beam voltage in crystalline amino acids as indicated by the fading of diffraction patterns indicated that the damage rates apparently decrease as the voltage is raised to 2.5 MeV. However, it was not possible to determine this variation quantitatively because of difficulties in measuring the absolute values of the critical exposures. (auth)

13345 CREEP STUDIES OF A 15Cr15NiTiB STEEL UNDER NEUTRON IRRADIATION AT 550°C. Closs, K. D. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 18: No. 4, 173-174(1973). (In German).

13346 NEW FILLER METALS RESIST RADIATION DAMAGE. Grant, S. P. (Babcock and Wilcox Co., Lynchburg, VA); Fortner, E. Weld. Metal. Fabr.; 41: No. 5, 148-149(May 1973).

The development of a new filler metal for medium-strength low-alloy steels, which may enable them to be used in nuclear vessels for light-water reactors is described. By restricting Cu and P contents to low levels, almost total resistance to fast-neutron irradiation damage at 550°F up to exposures of 2.8×10^{19}n/cm^2 (> 1 MeV) is achieved. Composition and properties of manual metal-arc and also submerged-arc welds are given, and results are shown for Charpy V-notch and radiation-strengthening tests. (UK).

Other Materials

Refer also to abstracts 12999, 13170, 13172, 13324, 13344, 13443, 14360, 14362, 14588, 14765, 14766, 14768, 14769, 14817, and 15152.

13347 (AAEC/E-257) MODIFIED VERSION OF THE BUSING–MARTIN–LEVY LEAST-SQUARES PROGRAM FOR THE DIRECT FITTING OF STRUCTURES TO POWDER-DIFFRACTION PATTERNS BY THE METHOD OF PROFILE ANALYSIS. Taylor, J. C.; Cox, G. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The Busing–Martin–Levy (BML) crystallographic least squares program was modified to handle the case of the overlapping diffraction data encountered in powder patterns. Each count along the scan is treated as a single observation and the pattern is considered to be the superposition of the (h, k, l) Gaussian peaks, as in the method of Rietveld (Acta Cryst., 22: 151(1967)). In this way the structure is fitted directly to the diffraction pattern, while details of the profiles are not lost. For this reason, together with the fact that a larger number of observations are used, the method is superior to conventional refinements with integrated intensities (which can also be done with the present program). (auth)

13348 (CEA-CONF-2246) ION IMPLANTATION USING NUCLEAR REACTIONS. Guernet, G.; Bontemps, A.; Marine, J.; Ligeon, E. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 10 Nov 1972. 13p. (In French). (CONF-720990-6). Dep. NTIS (U. S. Sales Only) $3.00.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

The $^{11}B(p,\alpha)$ nuclear reaction was used to examine the performance of a 180-keV ion implantation device. Homogeneity maps were obtained for Si samples in which large quantities of B ions had been implanted. An accuracy of 1% was obtained. Absolute measurements of the quantity implanted were made with an accuracy of between 25 and 30%; it is possible that the accuracy of such measurements could be improved to 10%. The different stages in the annealing of a ZnTe crystal lattice into which B ions had been implanted at 50 keV were studied by examining the backscattering spectra of α particles from this crystal after annealing. (FR)

13349 (CEA-R-4453) STUDY OF THE ELECTRONIC AND MAGNETIC PROPERTIES OF SOME ACTINIDE COMPOUNDS BY SPECIFIC HEAT MEASUREMENTS. Danan, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jul 1973. 138p. (In French). Dep. NTIS (U. S. Sales Only) $9.00.

Thesis. Submitted to Nancy Univ., France.

A calorimeter is described that measures specific heat between 1.5 and 300°K with a precision of 1%. Carbides, nitrides and sulfides of uranium and thorium were studied. ThC, ThN, ThS, $U_xTh_{1-x}S$, $UC_{1-x}N_x$. The radioactive compound Pu_2C_3 was also studied. The specific heat of the uranium compounds was calculated from those of the isomorphous thorium compounds by the "corresponding states" method. The analysis of the magnetic and electronic specific heat of the uranium compounds showed that a localized $5f^2$ configuration model does not correctly describe the phenomena in the case of the carbides and nitrides, but one cannot discard it in first approximation in the case of the sulfides, where it explains most of the magnetic properties. (17 tables, 41 figures, 95 references) (auth)

13350 (CONF-730703-1) RADIATION-INDUCED COMPENSATION AND DEFECT INTERACTIONS IN GERMANIUM. Cleland, J. W. (Oak Ridge National Lab., Tenn.). 1972. 4p. Dep. NTIS $3.00.

From conference on nuclear and space radiation effects; Logan, Utah, USA (23 Jul 1973).

A study was made of changes in net electrical carrier concentration and mobility in As- or Sb-doped n-type Ge (oxygen content $\leq 10^{14}$ cm^{-3}) after thermal neutron irradiation. Final donor concentration agreed with calculated value, and the final Hall mobility agreed with the total ionized impurity atom concentration (initial + ^{75}As + ^{71}Ga). The samples were converted to p-type, nearly intrinsic, with a defect state at E_v + 0.24 eV. After thermal neutron irradiation to ~90% or 110% compensation, an irradiation with ^{60}Co γ rays ($\geq 3 \times 10^{17}$ photons/cm^2) resulted in conversion of the 90%-compensated sample to p-type, with the E_v + 0.24 eV defect state, but there was no increase in acceptor concentration. Results indicate that previous models of defect structure are too simple. (DLC)

13351 (CONF-730707-2) APPLICATION OF FRACTURE MECHANICS TO GRAPHITE UNDER COMPLEX STRESS CONDITIONS. Yahr, G. T.; Valachovic, R. S. (Oak Ridge National Lab., Tenn.). 1972. 11p. Dep. NTIS $3.00.

The applicability of linear-elastic fracture mechanics to graphite under multiaxial stress conditions is examined. Earlier studies have demonstrated the applicability of fracture mechanics to graphite under a limited range of biaxial states of stress where one principal stress was tensile and the other was compressive. The study is extended to consider other combined stress states. The specimens used were thick-walled graphite cylinders with flat heads that were internally pressurized. Two series of specimens were used. The first series had complete circumferential notches machined diagonally into the head–cylinder juncture region, while the second series was unnotched. The methods of linear-elastic fracture mechanics and a finite-element analysis were used to predict pressures to cause fracture for both notched and unnotched specimens. In the latter case, it was necessary to postulate a size for a naturally occurring flaw. These predicted pressures were in good agreement with measured values. (auth)

13352 (EUR-4820(Vol.1)(Pt.D), pp 115-127) COMPARISON OF SIMPLIFIED STRESS–STRAIN RELATIONS FOR IRRADIATED GRAPHITE. Irving, J. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Constitutive laws for graphite are derived from constant-stress irradiation-creep data. The use of these laws in the stress analysis of creep and Wigner strains is discussed, and it is shown that a limiting steady-state stress solution will give a reasonable estimate of stresses due to buildup of Wigner strains under creep conditions. (auth)

13353 (EUR-4820(Vol.2)(Pt.D), pp 149-157) ELASTIC–PLASTIC THEORY FOR ARTIFICIAL GRAPHITE. Greenstreet, W. L. (Oak Ridge National Lab., TN); Phillips, A. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An elastic–plastic, time-independent phenomenological theory for the behavior of artificial graphite between 70 and 750°F is presented. The theory is based on the observation that, upon unloading, plastic deformation appears practically immediately after the loading reversal occurs. Thus, there exists no yield surface that encloses a purely elastic region. The theory incorporates the feature that, upon reloading, the stress–strain curve approaches asymptotically the extension to the initial stress–strain curve that would have existed, provided unloading had not occurred. The theory is developed for radial paths only. The paper ends with an illustrative example. (auth)

13354 (EUR-4820(Vol.2)(Pt.D), pp 159-181) ANISOTROPIC, ELASTIC–PLASTIC–THERMAL STRESS ANALYSES OF SOLID STRUCTURES. Weiler, F. C. (Aerotherm Corp., Mountain View, CA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The anisotropic, elastic–plastic–thermal response of solid structures is described. First, anisotropic, thermal plasticity theory is reviewed, followed by several numerical examples to indicate the importance of a correct material description. Finally, the behavior of mechanically and thermally loaded nuclear-grade graphites (typical of an environment in the core of a reactor) is explored to ascertain the elastic–plastic–thermal response of graphite under these conditions. (LMT)

13355 (EUR-4820(Vol. 4)(Pt.H), pp 41-55) DEFORMATION AND FRACTURE PROCESSES IN HARDENED CEMENT PASTE AND CONCRETE UNDER SHORT-TIME AND SUSTAINED LOAD. Wittmann, F. (Technische Univ. Munich); Zaitsev, Yu. Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The behavior of hardened cement paste and concrete under high sustained load was studied theoretically on the basis of fracture mechanics. In this connection it is necessary to use an idealized structure instead of the real structure of hardened cement paste. In was found that, with a given pore size distribution, the crack propagation becomes unstable beyond a certain load. This is the critical or ultimate load. In a visco-elastic material such as hardened cement paste, the critical mean crack length necessary for unstable crack propagation can be reached under a sustained load that is lower than the critical load in a short-time test. To test the described theory, experiments were carried out with hardened cement paste and concrete. The loss of strength was measured as a function of time and as a function of the age of the specimens. The experimental results were in good agreement with the theoretical predictions. Dried specimens of hardened cement paste showed very little creep. As a

consequence the loss of strength under sustained load is negligible for these specimens. (auth)

13356 (EUR-4820(Vol.4)(Pt.H), pp 57-69) EXPLOSIVE SPALLING OF CONCRETE EXPOSED TO HIGH TEMPERATURES. Sullivan, P. J. E.; Zaman, A. A. A. (Imperial Coll. of Sci. and Tech., London). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A series of tests to investigate explosive spalling of concrete exposed to high temperature is described. The variables studied include curing conditions, age and maturity, rate of heating and temperature gradient, and specimen size. The test results are analyzed by means of a simplified model. (auth)

13357 (EUR-4820(Vol.4)(Pt.H), pp 71-85) CONTRIBUTION TO THE BEHAVIOR OF CONCRETE UNDER MULTIAXIAL STRENGTH STATES. Bindseil, P. (Fried-Krupp GmbH Universalbau, Essen). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A planned test series is described that should give more detailed information on the triaxial strength of concrete and the effects of numerous different parameters. Moreover, a possible method for applying already known data is given by using the design of the THTR-PCPV as an example. Previous theoretical approaches used to solve the problem of the multiaxial strength of concrete, and the question of whether the application of modern continuum mechanics may be of use for further investigations are briefly discussed. (auth)

13358 (EUR-4820(Vol.4)(Pt.H), pp 87-101) CONCRETE REINFORCED WITH STEEL MICRO-REINFORCEMENT. Komlos, K. (Inst. of Construction and Architecture, Bratislava). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Short pieces of thin steel wire, at appropriately small spacings, are used as concrete reinforcement to arrest cracks. As an internal tensile crack propagates, displacements perpendicular to the plane of the crack develop in the immediate vicinity of the crack tip as a result of the stress singularity in that region. The presence of a stiffening element in the immediate vicinity of the crack opposes these displacements by adhesive bond between the stiffening element and the matrix. Therefore, the cracks do not propagate rapidly, as would be the case with plain concrete, but expand slower with increasing load. This is because of the energy required to strip the short wires free of their adhesion along the advancing crack front. Investigations have been carried out on concretes reinforced with 0.25, 0.50, 0.75 and 1.00 per cent of steel wires, having a diameter of 0.3 mm and a length of 30 mm. The results show that the increase of strength, due to the applied microreinforcement, varies slightly with the appropriate strength characteristic. The reinforcement seldom causes a higher increase of strength than 20 per cent. The increase of strength in cement pastes and mortars, determined by other investigators, was of a higher order. This is probably due to a higher percentage of microreinforcement applied in cement pastes and mortars, and the absence of coarse aggregates in these materials, affecting negatively the bond strength between microreinforcement and matrix. (auth)

13359 (EUR-4820(Vol.4)(Pt.H), pp 105-118) TIME-TEMPERATURE EXTRAPOLATION TECHNIQUES AS APPLIED TO CONCRETE CREEP STRAINS. Sullivan, P. J. E. (Imperial Coll. of Sci. and Tech., London). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Experiments carried out on concrete beams in flexure at temperatures above 100°C indicate that creep strains follow a semilog law when plotted against temperature. In line with other materials it can be shown that diffusion processes are involved in the mechanism of creep and that diffusion equations can be used to describe these strains. A modified form of Arrhenius equation for creep rates is developed and the creep results on gravel concrete in compression and on limestone concrete in compression are also shown to fit this equation. A technique similar to that developed by Dorn is used and found to give a fair representation of long-term creep strains at low temperature from short-term creep strains at higher temperature. (auth)

13360 (EUR-4820(Vol.4)(Pt.H), pp 119-127) NUMERICALLY STABLE ALGORITHM WITH INCREASING TIME STEPS FOR INTEGRAL-TYPE AGING CREEP. Bazant, Z. P. (Northwestern Univ., Evanston, IL). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The creep law of concrete is assumed to obey the principle of superposition and is expressed by hereditary integrals with non-convolution-type kernels, which are expanded in a degenerate form. For each material point, a set of certain additional hidden variables, fully characterizing the previous stress history, is defined, and it is found that in a step-by-step integration in time these variables can be computed from simple recurrent formulas. This makes storage of the past stress history unnecessary and circumvents thus the main obstacle for creep analysis of large structures. Unlike the step-forward integration with a rate-type creep law, the method is found to be stable for any size of the time step. This enables the time steps in relaxation-type problems to be gradually increased and the asymptotic values of stresses to be closely approached. Results of a simple numerical example corroborate this conclusion. (auth)

13361 (EUR-4820(Vol.4)(Pt.H), pp 129-143) MIGRATION OF MOISTURE AND PORE PRESSURES IN HEATED CONCRETE. England, G. L.; Sharp, T. J. (King's Coll., London). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The importance of water content on concrete properties is discussed in relation to ambient and moderately elevated temperatures. Methods of determining water contents in situ are cited, and attempts to relate changes of moisture content to shrinkage in simple specimens are mentioned. Experimental results from tests performed under sustained non-uniform and elevated temperatures are included and reveal that drying is encountered in the hottest regions of the concrete mass in addition to boundary areas associated with free evaporation of water to the atmosphere. Simple diffusion theory based on concentration of water is incapable of predicting these moisture distributions, and a method of prediction is sought that recognizes the pore air and vapor pressures as additional factors that cause moisture to migrate down the temperature gradient. Comparisons of experimental results and theoretical predictions are made for a concrete cylinder subjected to a longitudinal temperature crossfall of 110°C and a maximum temperature of 150°C. It is concluded that although simple diffusion theories may be adequate for specifying drying at ambient temperatures they do not provide adequate representation in regions of high temperature, and recognition must be given to other more influential factors such as pore pressures in these regions. (auth)

13362 (EUR-4820(Vol.4)(Pt.H), pp 145-162) MOISTURE MIGRATION IN CONCRETE. Vos, B. H. (Inst. TNO for Building Materials and Building Structures, Delft, Netherlands). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In a moist porous material water as well in the liquid phase as in the gaseous phase is present. A description of moisture migration therefore must be based upon a continuous and differentiable potential concept valid in both phases. This potential concept is introduced. However, a potentialmeter has not been developed and a direct application of a potential equation in practice is not possible. Two possibilities of splitting up the equation into two parts exist. For higher moisture contents a description of moisture migration based upon a moisture content and a temperature gradient is recommended. For lower moisture contents (hygroscopic range) a splitting up into a vapor pressure gradient and a temperature gradient is advisable. The transfer coefficients to a high degree depend upon moisture content. In some cases the temperature-gradient terms can be neglected. By introducing the concept "critical water content", Fourier's differential equation with a constant diffusivity parameter is made valid. This approach can be used for the description of water penetration into materials by capillary suction, condensation phenomena and drying. The latter phenomenon is analyzed; experimental and theoretical results are compared. No results of experiments on concrete are available. (auth)

13363 (EUR-4820(Vol. 6)(Pt. L), pp 109-131) CREEP OF A UNIAXIAL METAL-MATRIX COMPOSITE SUBJECTED TO AXIAL AND NORMAL LATERAL LOADS. Branca, T. R.; Boresi, A. P. (Univ. of Illinois, Urbana). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A displacement formulation of the finite-element method is used to solve the generalized plane-strain problem of the creep

of a uniaxial metal matrix composite subjected to axial load and normal lateral loads. Inelastic strains are considered as initial strains in the finite-element analysis. The composite is examined from a micromechanical point of view. Particular boundary conditions resulting from rectangular close-packed filament spacing are included in the analysis. For the special case of no lateral loads, analytical predictions are compared to experimental results for a composite of copper wires embedded in a lead–tin alloy matrix. The finite-element method provides an efficient solution to this problem. Analytical results so obtained agree well with experimental results. Furthermore, for sample cases of zero lateral loads, axial strain of the composite as predicted by the finite-element method agrees well with a composite mixing-law prediction. Analytical results are also given for a silicon carbide–titanium composite subjected to axial and lateral load combinations. For this composite system under axial loading (zero applied lateral loads), the mixing-law solution is again adequate to predict the axial strain; however, it is shown that lateral interaction has a significant influence on the stress state within the matrix of the composite. (auth)

13364 (SLA-73-385) APPLICATION OF ENGINEERING DATA ON CARBON FIBERS TO CARBON/CARBON COMPOSITES. Butler, B. L. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 19p. Dep. NTIS $3.00.

The purpose of this paper is twofold: first, to present a compilation of current (3/73) manufacturers' data on carbon fibers for fiber selection and, second, to indicate how these data can be used to aid in fiber selection for carbon fiber/pyrocarbon matrix composites. The manufacturers' reported properties are defined and tabulated. The carbon fiber properties necessary to predict the tensile strength and Young's modulus of carbon fiber/chemical-vapor-deposited (CVD) carbon matrix composites are significantly different from manufacturers' reported data. The effective physical properties of the fibers in the CVD matrix are controlled by strand mechanics and may also be altered by heat treatments. The standard methods of determining fiber properties are contrasted with those needed for carbon composite analysis. Also a scheme for determining the effects of heat treatment on fiber mechanical properties is presented. (auth)

13365 (UCRL–51372) TIME-RESOLVED VOLTAGE BREAKDOWN IN VARIOUS INSULATORS DUE TO 2-MeV ELECTRONICS. Erickson, L. M.; Oakley, D. C. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Apr 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

A pulsed beam of electrons from a 2-MeV Febetron was injected into several insulating materials and the resultant self-breakdown characteristics of the materials were studied. The materials included lucite, vinyl chloride, polyethylene, Teflon, pyrex, type 815 epoxy, and pyrex glass. The threshold for formation of Lichtenberg figures was established for several of the materials. High-speed photography was used to observe the figures as they formed in some of the transparent materials, and propagation velocities were established for some exposure levels. Propagation velocities were found to vary as a function of exposure level for those materials and exposure levels in which we were able to obtain a measurement. Intensity of the main stems of the figures was increased in small pellets of some materials by exposing them in a liquid dielectric bath; that is, electrons deposited in the liquid apparently discharged through the main stems of the pattern in the solid dielectric to a grounded point on the back center of the solid material. It is much more difficult to form Lichtenberg figures in solid dielectrics composed of two separate insulators such as Lucite granules cast in epoxy. The Lichtenberg figures did not cross boundaries between the materials at our exposure levels and conditions. (19 figures) (auth)

13366 (Y–1875) PROPERTIES OF CARBON DERIVED FROM PETROLEUM PITCHES. Horne, O. J.; Smith, W. E.; Napier, B. (Oak Ridge Y-12 Plant, Tenn. (USA)). 21 Jun 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $4.00.

The effect of temperature and various additives on the properties of petroleum pitches, and carbons derived from these pitches, were studied. Pitch properties were monitored by molecular weights, softening points, and benzene insolubles; carbon properties were evaluated by crystallography, metallography, and density studies. In thermal studies, two petroleum pitches were found to be relatively stable for extended periods at 250°C. By blending various additives with samples of one of the pitches, prior to pyrolysis, a wide variety of carbon properties were obtained, thus affording avenues to control these properties by controlled modification of the precursors. (auth)

13367 OVERVIEW OF X-RAY EFFECTS PHENOMENOLOGY. Picarelli, J. G. (Air Force Weapons Lab., Kirtland AFB, NM). Trans. Amer. Nucl. Soc.; 16: 353(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13368 EFFECTS OF PHOTOELECTRON MIGRATION ON X-RAY DEPOSITION IN COMPOSITE MATERIALS. Parks, D. E.; Fisher, R. H. (Systems, Science, and Software, La Jolla, CA). Trans. Amer. Nucl. Soc.; 16: 355(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13369 SURFACE ASPECTS OF NEW FIBERS: BORON, SILICON CARBIDE, AND GRAPHITE. Scola, D. A.; Brooks, C. S. J. Adhes.; 2: 213-237(Jul 1970).

A review of the literature for surface characteristics of boron, silicon carbide and graphite fibers was made. Some of the physical and chemical characteristics of the surfaces of these fibers are described. Surface properties that are unique as well as common to each fiber are discussed. Comparisons of these fiber surface properties to those of glass fibers are made in efforts to bring out differences and similarities. The strength of the "bond" at the fiber/resin interface in high modulus fiber-reinforced composites is described. The problems associated with defining the chemical and physical nature of the fiber surfaces which are most relevant to the development of composites with optimum mechanical properties are pointed out. (App. Mech. Rev.)

13370 ELECTRON PARAMAGNETIC RESONANCE AND OPTICAL STUDIES OF PENTAVALENT URANIUM. Lewis, W. B.; Hecht, H. G.; Eastman, M. P. (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem.; 12: No. 7, 1634-1639(Jul 1973).

EPR and optical spectra are reported for uranium-doped $LiNbO_3$, $LiTaO_3$, and $BiNbO_4$. The U^{5+} ion gives rise to an EPR signal at $|g| \sim 0.7$ and appears to be a site of almost regular octahedral symmetry in every case. An analysis of the data yields crystal field splittings and orbital reduction factors similar to those involved in the previously studied octahedral fluorides. Attempts to prepare magnetically dilute U^{5+} in oxides with the perovskite structure were unsuccessful. An EPR absorption was found at approximately $|g| = 1.2$ in Na_3UF_8 at 7°K, which is attributed to U^{5+} in eightfold cubic coordination. (auth)

13371 U–S–Te SYSTEM. Ellert, G. V.; Slovyanskikh, V. K. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 18: No. 6, 1657-1662(Jun 1973). (In Russian).

The ternary system U–S–Te was studied in the area of the polythermal (400 to 1060°C) section at a constant 25 at.% U. Limited solid solutions containing the compounds US_3 and UTe_3, solid solutions of the composition $US_{3-x}Te_x$, and solid solutions containing the phase β-US_2 were formed. Differential thermal, x-ray, and chemical analyses were employed in evaluating the system. (tr-auth)

13372 MAGNETIC PROPERTIES OF UAs–USe ALLOYS IN A MAGNETIC FIELD UP TO 80 kOe. Palewski, T.; Suski, W.; Mydlarz, T. (International Lab. for High Magnetic Fields and Low Temperatures, Wroclaw). Int. J. Magn.; 3: No. 4, 269-272(Dec 1972).

The magnetization of seven samples from the $UAs_{1-x}Se_x$ system was investigated in the temperature region 4.2 to 200°K and in a magnetic field up to 80 kOe. The samples with $x = 0.04$, 0.01, and 0.15 appear to be antiferromagnetic in the whole temperature and field region, those with $x = 1$ and 0.60 are ferromagnetic with a peculiar dependence of the magnetization on temperature, while in the samples with $x = 0.33$ and 0.25 the coexistence of ferro- and antiferromagnetism is observed. (auth)

13373 KHIMICHESKAYAS SVYAZ V POLUPROVODNIKAKH I POLUMETALLAKH. (Chemical Bond in Semiconductors and Semimetals). Sirota, N. N. (ed.). Minsk; Izdatel'stvo Nauka i Tekhnika (1972). 456p.

Theoretical and experimental investigations of the chemical bond in semiconductors and semimetals were presented in 58 papers by various authors as part of an international conference in Minsk. The papers are grouped by subject as follows: x-ray spectral and x-ray diffraction studies, physical properties of crystals and the character of the chemical bond, lattice dynamics, and thermodynamics. Of particular interest here were discussions of TiN, VN, $VC_{0.88}$, U_3P_4, U_3As_4, and In and La alloys. Compton profiles of B, B_4C, BN, BeO, LiF, and MgO are examined. (KSW)

13374 INFLUENCE OF ELECTRON BOMBARDMENT ON THE HIGH-VOLTAGE ANOMALOUS PHOTOVOLTAIC EFFECT IN FILMS OF Si AND Ge. Abdullaev, N.; Ayukhanov, A. Kh.; Arifov, U. A. (Inst. of Electronics, Kiev). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 34-36(1973). (In Russian).

The effect of electron bombardment (up to 10 keV) on the photoelectric characteristics of Si and Ge films was investigated. Irradiation of the films with electrons produced decreases in both

the photovoltage and the resistance of the films: ~2 keV for Si and ~100 eV for Ge. At much higher electron energies (E > 5 keV for Si and E > 500 eV for Ge) relatively small doses of radiation lead to the complete loss of photovoltage and to a decrease in the resistance by a factor of two or three. (KSW)

13375 PRODUCTION OF F AND F-AGGREGATE CENTRES IN CaF_2 AND SrF_2 BY IRRADIATION. Hayes, W.; Lambourn, R. F. (Oxford Univ.). Phys. Status Solidi (b); 57: No. 2, 693-699(1973).

The efficiency of production of F centers in CaF_2 by x irradiation was studied as a function of temperature and compared with the results of an earlier detailed investigation of SrF_2 (J Phys. C6; 11(1973)). The efficiency begins to fall gradually at about 20°K and at 100°K has reached a very low value. It does not recover at higher temperatures. It is found that M^+, M, and R centers can be produced in CaF_2 and SrF_2 after intense irradiation with 1-MeV electrons at 77°K. The measured optical properties of these centers are identical with those found in additively colored crystals. Mechanisms for the production of F and F-aggregate centers in irradiated crystals are discussed. (auth)

13376 INTERACTION OF DEFECTS AND IMPURITIES IN SILICON CONTAINING IMPLANTED IONS. Gerasimenko, N. N.; Dvurechenskii, A. V.; Romanov, S. I.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 10, 1692-1694(Apr 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 10, 1978-1981 (Oct 1972).

The ESR method and the diffraction of reflected fast electrons were used to study the interaction between defects generated by ion bombardment and impurities introduced by diffusion or ion implantation. It was found that paramagnetic defects (VV centers) disappeared at a certain concentration of the implanted boron and phosphorus atoms. Further bombardment of a nonparamagnetic amorphous layer restored the original crystal structure and the restored regions had fewer defects when P^+ ions were used. This effect was not observed when silicon was bombarded with Ar^+ ions. (auth)

13377 RADIATION-STIMULATED FORMATION OF COMPLEXES IN P-TYPE INDIUM ANTIMONIDE. Vitovskii, N. A.; Vikhlii, G. A.; Mashovets, T. V. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 10, 1703-1708(Apr 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 10, 1995-2002 (Oct 1972).

Indium antimonide doped with germanium or iron was irradiated at low temperatures with x rays of 250 keV maximum energy. This irradiation reduced the concentrations of shallow acceptors and donors, raised the mobility in the impurity scattering region, and increased the activation energy of the shallow acceptors, which tended to a value ϵ_1 typical of isolated impurity centers. The results could be explained on the hypothesis of radiation-stimulated migration of impurities accompanied by the formation of neutral acceptor–donor complexes. (auth)

13378 EFFECT OF γ IRRADIATION ON DIELECTRIC PROPERTIES OF THIN ORGANOSILICON FILMS. Tkachuk, B. V.; Kobtsev, Yu. D.; Laurs, E. P.; Mikhal'chenko, V. I. (Kiev Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 107-109 (1973). (In Russian).

Films of polymerized octamethyltrisiloxane (OMTS) and vinylheptamethyltrisiloxane (VHMTS), were irradiated in air at room temperature using a ^{60}Co source, after which the tangent of the angle of dielectric loss was measured (tan δ). Values of tan δ increased in an Al/film/Al structure for doses greater than 10 MR. For γ-radiation doses >50 MR a saturation effect was manifest, so that little or no change in the dielectric properties of OMTS or VHMTS was noted with increased radiation dose. (KSW)

13379 INFLUENCE OF PROTON RADIATION IN A VACUUM ON THE PROPERTIES OF POLYMERIC FILMS. Barbashev, E. A.; Bogatov, V. A.; Panshin, B. I. (All-Union Scientific Research Inst. of Aviation Materials, Moscow). Fiz. Khim. Mekh. Mater.; 8: No. 6, 66-68(1972). (In Russian).

Films of polyethylene terephthalate (PETP), and polyvinyl chloride (PVC) were irradiated in a vacuum at 10^{-6} torr with 200 keV protons at 0.014, 0.028, and 0.14 $\mu A/cm^2$. Gaseous radiolysis products were analyzed with a mass spectrometer. Both the strength and elongation-to-rupture tests showed that the polymeric samples became weaker with increased radiation dosage. Radiolysis products from PETP included a large acetaldehyde peak; those from PVC included significant amounts of HCl. (KSW)

13380 ON-LINE SHEET CONDUCTIVITY MEASUREMENTS DURING ION BOMBARDMENT OF ION-DOPED SILICON LAYERS. Andersson, A.; Eklund, K. H.; Swenson, G. (Chalmers Tekniska Hoegskola, Goteborg). Radiat. Eff.; 17: No. 3-4, 159-166(1973).

A method by which the sheet conductivity can be measured continuously during and after ion bombardment of ion-doped silicon layers is described in detail. The temperature dependence of the damage created by 30-keV ^{31}P ions in silicon doped with phosphorus was studied between −186°C and 102°C. It is found that the conductivity during the bombardment decreases almost exponentially with the ion dose. The annealing behavior of the created defects was studied isothermally at the bombardment temperature and isochronally up to 600°C. The results obtained are compared with measurements on neutron-irradiated silicon. (auth)

13381 USE OF DISSOLUTION CURVES TO DETERMINE AMORPHIZATION DEPTHS AND DAMAGE RANGES IN SILICON. Reid, I.; Kelly, R. (McMaster Univ., Hamilton, Ont.). Radiat. Eff.; 17: No. 3-4, 253-260(1973).

Amorphization depths in ion-bombarded Si can be readily measured with dissolution curves, i.e., curves giving the residual activity of the implanted ions versus the time of exposure to an $HF-H_2O_2$ mixture. The depth calibration is established by comparison with integral ion distributions. Amorphization depths were determined in this way both for room-temperature Kr implants (where they range from 35 to 60 Å at 2 keV, to 105 to 205 Å at 10 keV, to 395 to 570 Å at 40 keV) and for Kr implants at 95 to 360°C (where they are consistently smaller). An important application of amorphization-depth (R_a) measurements lies in deducing mean projected damage ranges ($\langle x_d \rangle$). Thus it is argued that the following quantity must be independent of dose (Bt) for a given energy: $\gamma \approx (Bt) \exp\{-1.28(R_a/\langle x_d \rangle - 1)^2\}$, where the constant "1.28" is an approximation which is valid for intermediate mass ratios and for energies such that $\epsilon \leq 1$. Solution of this relation gave the result that $\langle x_d \rangle$ was 25 ± 2.5 Å at 2 keV, 70 ± 10 Å at 10 keV, and 190 ± 15 Å at 40 keV. The present experiments also yield estimates of the rate of dissolution of Si in $HF-H_2O_2$ or HF and of the threshold dose for amorphization. (auth)

13382 DISORDER ANNEALING IN 3–5 SEMICONDUCTORS AFTER ION IMPLANTATION AT LOW TEMPERATURES. Picraux, S. T. (Sandia Labs., Albuquerque, NM). Radiat. Eff.; 17: No. 3-4, 261-267(1973).

Undoped GaP, GaAs, GaAsP, and GaSb were implanted near liquid-nitrogen temperature with 110-keV Zn ions. Implantations with O, Sb, and Xe between 110 and 150 keV were performed for comparison. The implantation-induced lattice disorder was studied without warm-up and as a function of isochronal anneal temperatures by ion channelling and backscattering measurements using 1.5-MeV He^+ or 450-keV protons. For low-fluence implants where the initial disorder peak is ≲30% of the level for amorphous layer formation, the annealing is found to be characteristic only of the target compound. Broad anneal stages centered at 320, 250, and 290°K are observed for GaP, GaAs, and GaSb, respectively. GaAsP annealing occurs at temperatures intermediate between that for GaP and GaAs. For higher fluence implants, where channeling measurements indicate that an amorphous layer is formed, the disorder annealing is strikingly similar for the III–V compounds studied with a single annealing stage centered at 530°K. The scattering yields from the displaced A and B atoms can be resolved for GaP and GaSb, and no difference in the anneal recovery of the A and B sublattices is observed within the resolution of these experiments. (auth)

13383 NEW METHOD FOR DETERMINING BREAKDOWN OR ION IMPLANTATION PROFILES IN INSULATOR LAYERS. Schmidt, M.; Glaefeke, H.; Drenckhan, J.; Wild, W. (Univ., Rostock, Ger.). Radiat. Eff.; 17: No. 3-4, 185-190(1973). (In German).

Thermally stimulated exoelectron emission after excitation by electrons can be used to determine the breakdown and/or implantation profiles of insulating layers if the trap concentration produced by the implantation is proportional to the breakdown and/or implantation profile. The determination of the profiles is realized by filling the traps of the insulating layer successively in layers with electrons. For this purpose the energy of the electrons bombarding the insulating layer is raised step by step. Before electron bombardment energy is raised to the following step, the trapped electrons are released into the conduction band of the insulator by heating the sample. Because of the electrical field built up inside the insulating layer, the liberated electrons are emitted into vacuum. These emitted electrons, the exoelectrons, carry information about the traps they are coming from. Investigation of nitrogen-ion-implanted SiO_2-layers showed that, in this case, the trap profile is correlated with the implantation profile. Results are in good agreement with implantation theory. (auth)

13384 IRRADIATION OF LAVRION FLUORITE. Olympios, E.; Konstantos, J.; Marakis, G. (Democritus Nuclear Research Center, Athens). Radiat. Eff.; 17: No. 3-4, 235-239(1973).

Fluorite from Lavrion, Attiki, Greece was found to contain transparent and semi-transparent regions. The ir spectra of the semi-transparent regions of the fluorite showed the presence of water,

CO_2, and of the anions CO_3^{2-}, NO_3^-, SO_4^{2-}, and PO_4^{3-}. Solid inclusions such as galena, sphalerite, and chalcopyrite were also found in both regions. The formation temperature of this fluorite is estimated to be lower than 190°C. The optical absorption spectra of the two regions show, after irradiation, the same bands at about 590, 400, 320, and 250 nm. The intensity of some of these bands, however, is significantly different between the two regions. The bands at 590 and 320 nm are attributed to color centers. It is proposed that the band at 400 nm is due to an electronic transition within the ion $Y^{2+}(4d^1)$. It is suggested that the existence of blue or green fluorite exhibiting the Smakula spectrum may indicate the presence of radioactive minerals. (auth)

13385 SOME NEW ASPECTS FOR THE EVALUATION OF DISORDER PROFILES IN SILICON BY BACKSCATTERING. Schmid, K. (Technische Hochschule, Munich). Radiat. Eff.; 17: No. 3-4, 201-207(1973).

An attempt was made to solve the four main problems arising with the investigation of disorder profiles in silicon that had been damaged by ion implantation. These problems are the dechanneling effect, the experimental energy resolution, the backscattering probability, and the energy–depth scale. The dechanneling analysis used is exact for single scattering of the analyzing particles. The integral dechanneling probability was found to increase with decreasing disorder density, which is in contrast to single and multiple scattering theory. Local defect structures may be responsible for this effect. The influence of the limited energy resolution of the experimental apparatus is taken into consideration by a somewhat varied deconvolution analysis. It is shown that the energy dependence of the backscattering probability can be expressed by the Rutherford formula with sufficient accuracy. The evaluation of the energy–depth scale is based on experimental energy-dependent data for the stopping power of the analyzing particles in the sample. (auth)

13386 CHANNELING STUDIES OF ION-IMPLANTED SILICON. Sigurd, D.; Bjoerkqvist, K. (Research Inst. for Physics, Stockholm). Radiat. Eff.; 17: No. 3-4, 209-220(1973).

The channeling effect was used to study the lattice location of Sb, Bi, and Pb implanted into Si. Angular scans through the ⟨111⟩, ⟨110⟩, and ⟨100⟩ axes show that the channeling dips obtained in 1-MeV He ion scattering measurements are significantly narrower for the impurities than for the Si host lattice. Annealing of Sb-implanted samples at 900°C results in a broadening of the Sb dip but not to the full Si width. Measurements on diffused Sb samples give wider Sb dips than for implanted Sb. Calculations of channeling angular distributions using the average potential model, imply that the smaller widths of the impurity dips can be caused by a small equilibrium displacement of the impurity atoms from lattice sites. Preliminary measurements on B-implanted Si crystals annealed at 950°C for 30 minutes, indicate that the dip width obtained from the $^{11}B(p,\alpha)^8Be$ reaction at 670 keV does not differ significantly from that obtained from 670-keV proton scattering off Si. (auth)

13387 SURFACE STUDIES ON GRAPHITE. Desorption of Surface Oxide. Barton, S. S. (Royal Military Coll. of Canada, Kingston, Ont.); Harrison, B. H.; Dollimore, J. J. Chem. Soc., Faraday Trans., I; 69: No. 6, 1039-1048(1973).

The kinetics of desorption of surface oxide as CO and CO_2 from graphite have been followed, using a mass spectrometer system, allowing their activation energies of desorption to be measured as a function of the amount desorbed. After the initial degassing of the graphite, surface oxide was reformed by chemisorption at 298°K and 573°K, and oxygen pressures of 760 and 0.2 torr, respectively. Similar analysis of the desorption kinetics of these oxides, formed under controlled conditions, has allowed a comparison of their desorption energetics to be made. (auth)

13388 FORMATION AND DESTRUCTION OF M CENTERS IN KCL BY AN IONIZING RADIATION AT ROOM TEMPERATURE. Herrmann, F. (Institut Nacional de Sciences Appliquees de Lyon, Villourbanne, France). Cryst. Lattice Defects; 3: No. 3, 167-169(Aug 1972).

The rate of destruction of M centers in KCl at RT by electron irradiation was found to be proportional to $j \cdot n_M/n_F$, with n_F and n_M the F and M center concentrations and j the current density. It follows that the formation rate is proportional to the first power of n_F. It is concluded that α centers are formed in the primary creation process of radiation defects. (auth)

13389 INTERSTITIAL AND TRAPPED-HOLE CENTERS IN ALKALI HALIDES. Itoh, N. (Nagoya Univ., Japan). Cryst. Lattice Defects; 3: No. 3, 115-143(Aug 1972).

Experimental and theoretical studies of the interstitial and trapped-hole centers in alkali metal halides are surveyed. Emphasis is given on the centers whose identification has been made relatively clear. The most fundamental interstitial centers are the isolated atom interstitial center, the H center and the isolated ion interstitial center, the I center. The former has been identified clearly by EPR and ENDOR experiments. Some pieces of circumstantial evidence for the existence of the latter has been presented. Two types of the motion of interstitial centers is of primary importance: the thermal motion of the I and H centers and motion of atom crowdion. Experimental results on the thermal motion and the crowdion motion are reviewed, although only little information has been obtained on the motion of the crowdion. The interaction of interstitial centers plays an important role in the formation of Frenkel pairs. Both atoms and ion interstitial centers associated with impurities are presented, and their properties as well as the nature of interaction force are discussed. The Coulomb and elastic forces are considered to be the main cause of interaction. Interaction between two H centers is also discussed. This interaction takes place both during thermal migration and during crowdion motion. The qualitative electronic properties of the atom interstitial centers as well as the V_k center are described well in terms of those of the X_2^- molecule ion. The detailed electronic properties, however, are affected by the coupling with the valence band. Although the properties of the interstitial ion centers are not known very well, it is shown that a p-electron of an interstitial halogen is excited leaving a missing p-shell, which relaxes into an X_2^- molecule ion. (14 figures, 13 tables, 199 references) (auth)

13390 CONCENTRATION, SOLUBILITY, AND EQUILIBRIUM DISTRIBUTION COEFFICIENT OF NITROGEN AND OXYGEN IN SEMICONDUCTOR SILICON. Yatsurugi, Y. (Komatsu Electronic Metals Co., Hiratsuka, Japan); Akiyama, N.; Endo, Y.; Nozaki, T. J. Electrochem. Soc.; 120: No. 7, 975-979(Jul 1973).

The concentration of nitrogen and oxygen in semiconductor silicon and their solubilities in silicon at its melting point were measured by charged particle activation analysis and infrared spectrophotometry. It was found that: (i) commercial semiconductor silicon contains less than 1×10^{15} atoms/cm³ of nitrogen in the un-ionized state; (ii) the solubility in solid silicon is $4.5 \pm 1.0 \times 10^{15}$ atoms/cm³ for nitrogen and $2.75 \pm 0.15 \times 10^{18}$ atoms/cm³ for oxygen; and (iii) the solubility in liquid silicon is about 6×10^{18} atoms/cm³ for nitrogen and $2.20 \pm 0.15 \times 10^{18}$ atoms/cm³ for oxygen. Thus, the equilibrium distribution coefficient was determined to be about 7×10^{-4} for nitrogen and 1.25 ± 0.17 for oxygen. The solubilities of the two elements are compared with those of other elements, especially carbon, and are discussed thermochemically. (6 figures, 24 references) (auth)

13391 SOLID–SOLID VACUUM DIFFUSION PROCESSES IN SILICON. Gereth, R.; Kostka, A.; Kreuzer, K. (AEG-Telefunken, Heilbronn, Ger.). J. Electrochem. Soc.; 120: No. 7, 966-971(Jul 1973).

Two diffusion techniques are described making use of doped silicon wafers as the diffusion source. The processes are carried out either in an evacuated capsule or inside a high-vacuum furnace. Using the capsule technique, boron and phosphorus layers in silicon were produced, with sheet resistances ranging from approximately 20–4000 ohms/□, and junction depths between approximately 0.3 and 15 μm. Good uniformity and reproducibility of results were obtained, with relative variations below 3% across one wafer, from wafer to wafer, and from run to run. In a series of boron diffusions, the high-vacuum technique yielded results comparable to the capsule technique. It offers more experimental flexibility but requires masking layers other than SiO_2 for the production of planar devices. (8 figures, 4 tables, 13 references) (auth)

13392 SYNTHETIC PREPARATION AND LATTICE STRUCTURE OF THORITE. Sinha, D. P. (Patna Univ., India); Prasad, R. J. Inorg. Nucl. Chem.; 35: No. 7, 2612-2614(Jul 1973).

Thorite was prepared in sealed pyrex glass tubes by heating thorium chloride solution at 180°C. A reaction mechanism is proposed. The synthetic product having a tetragonal structure has the space group $D_{4h}^{19} - I4_1/amd$ with 4 mole in the unit cell. The lattice parameters found from x-ray-diffraction powder photographs were a = 7.148 Å, c = 6.309 Å and c/a = 0.882. The oxygen positions were at x = 0.169 and z = 0.357. (UK)

13393 TEMPERATURE COEFFICIENT OF FREE SURFACE ENERGY OF PYROGRAPHITE. Kostikov, V. I.; Kharitonov, A. V. (Inst. of Steel and Alloys, Moscow). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 16-17(1972). (In Russian).

The temperature dependence of the surface energy of pyrographite is experimentally determined. The method involves introducing a wedge into a crack made in a pyrographite plate and measuring the geometric parameters of this crack. This system is then annealed, and the reduction in free surface energy resulting from heating is determined by a formula which defines the temperature coefficient of the variation in free energy in terms of the increase in the length of the crack and the change in tempera-

ture. It was found that the mean temperature coefficient of free surface energy of pyrographite is close to -0.05 mJ $\cdot$ m^{-2} $\cdot$ K^{-1}. This seems reasonable since the temperature coefficient of free energy for solids should be less than for liquids. (JPRS)

13394 INTERSTITIAL NITROGEN DEFECTS IN GALLIUM PHOSPHIDE. Morrison, S. R.; Newman, R. C. (Univ. of Reading, Eng.). J. Phys., C (London); 6: No. 11, L223-L225(11 Jun 1973).

Nitrogen-doped gallium phosphide was irradiated with fast neutrons or 2-MeV electrons. These treatments lead to the formation of interstitial defects involving nitrogen that give rise to localized vibrational modes at 946.7 cm^{-1} (^{14}N) and 925.2 cm^{-1} (^{15}N). These defects anneal at about 530 K. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 12932 and 12941.

13395 (UCRL-74514) PHYSICAL SECURITY: TODAY. Becker, R. C. (California Univ., Livermore. Lawrence Livermore Lab.). 29 May 1973. 5p. (CONF-730630-1). Dep. NTIS $3.00.

From 14th annual institute of nuclear materials management conference; San Diego, California, USA (20 Jun 1973).

An aggressive, imaginative, and creative physical security program, incorporating the latest technology, should be a basic part of all programs for managing nuclear materials. At the Lawrence Livermore Laboratory attempts to use some of the same tools and technology that are normally used to help solve scientific problems are employed. These systems include: computer access by individual numbers (CAIN), police alarm communications control (PACC), and broad-coverage television systems. These systems represent large initial capital investments, but the expenditures have been justified in terms of reduced operating costs and better security. (auth)

13396 ISOTOPIC DATA AND SAFEGUARDS. Christensen, D. C.; Prezbindowski, D. L. (Battelle-Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 65-66(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13397 γ-RAY MEASUREMENTS FOR NUCLEAR MATERIAL ACCOUNTABILITY. Reilly, T. D.; Parker, J. L. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 68-69(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

Disposal and Storage

Refer also to abstracts 12764, 12765, 12865, 12868, 14415, and 14416.

13398 (ARH-SA-162) STORAGE OF RADIOACTIVE HIGH-LEVEL WASTE. Barnes, J. W. (Atlantic Richfield Hanford Co., Richland, Wash.). [nd]. 22p. Dep. NTIS $3.25.

A conceptual design of a storage facility for high-level radioactive wastes is presented. The wastes are contained in stainless steel canisters which are stored in a water basin. The water is circulated around the canisters to remove heat. A cooling tower is provided to maintain the water below 120°F. (TFD)

13399 (ORNL-TM-4274) RADIOACTIVE GAS STORAGE TANK DISCHARGE MODE FOR MINIMAL ENVIRONMENTAL IMPACT. Baumann, C. D. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 12p. Dep. NTIS $3.00.

The manner in which the radioactive gases (frequently as trace quantities in a high pressure "carrier" gas) are released from storage tanks is considered. The release may be by (1) holding the gas as long as possible in the storage tanks, and then discharging the contents over a rather short time interval; (2) discharging the tank contents over a reasonable time interval at a constant fractional pressure rate, or (3) discharging the contents over a reasonable time interval at a constant activity rate. (DHM)

13400 (ORNL-tr-2684-A) DISPOSAL OF RADIOACTIVE WASTES FROM NUCLEAR POWER PLANTS. Part 1. Text. Final Report for the Period January 1, 1970-December 31, 1971. Witte, H.; Herzog, J.; Christ, J. Translated from a German Report. 58p. Dep. NTIS $5.00.

The radioactive wastes produced in coolant treatment and waste effluent processing of nuclear power plants were investigated with regard to their quantity and specific activity. In accordance with the safety regulations applying to disposal in the Asse salt mine, it was found that immobilization of the waste with insoluble binders was necessary and highly desirable. In addition to immobilization processes for waste processing, there are also methods available which provide for concentrating the wastes. Although concentration is the most economical process to perform at a nuclear power plant, an overall view of the process chain from transport to processing to final disposal demonstrates that immobilization in a large central facility servicing several nuclear power plants represents the technical and economical optimum and at the same time the safest method for the disposal of these wastes. (auth)

13401 DEEP SELF-BURIAL OF RADIOACTIVE WASTES BY ROCK MELTING CAPSULES. Logan, S. E. (Univ. of New Mexico, Albuquerque). Trans. Amer. Nucl. Soc.; 16: 177-178 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13402 STORAGE OF RADIOACTIVE WASTES IN SALT MINES. Arch. Energiewirt.; 27: No. 4, 146-150(1973). (In German).

Abandoned salt mines are used by the USAEC for the disposal of radioactive wastes. The main advantages of this disposal method are large spatial extension of the salt vaults, low cost for the preparation of the mines, tightness of the rock salt against intrusion of water, good thermal conductivity, and little danger of earthquakes in the area of salt mines. Ground plans of mines, practical storage experiments, and the delivery of wastes are briefly described. (GE)

13403 MARINE DISPOSAL OF SOLID RADIOACTIVE WASTES. A Survey of World Operations. Branca, G. (CNEN, Cassica, Italy). Ing. Sanit.; 20: No. 2, 63-76(1972). (In Italian).

The technical, scientific, ecological, legal, and economic aspects of marine disposal of solid radioactive wastes are examined. Historical and worldwide surveys of such disposals up to 1972 are presented. International operations carried out under the control of ENEA on the radioactive wastes of European nations are discussed. International agreements and recommendations, legality and wisdom of such disposals, and the US suspension of sea disposal are discussed. (INIS)

13404 SELECTION OF A SITE FOR THE GROUND DISPOSAL OF RADIOACTIVE WASTES. 3. Selection of a Ground Disposal Site for Radioactive Wastes by Means of a Computer. Inoue, Y.; Morisawa, S. (Kyoto Univ.). Nippon Genshiryoku Gakkaishi; 15: No. 2, 126-135(Feb 1973). (In Japanese).

A method for systematically selecting the optimum locations for the disposal of radioactive wastes with the aid of a computer, based on certain reasonable assumptions and on the experimental data required in estimating the radiological hazards to the human body caused by the disposed wastes in a nuclear facility along a coast, is presented. The calculation was made on a model nuclear facility selected to show the general method of selection of a ground disposal site. The optimum condition for the ground disposal site is defined as that which causes minimum internal dose caused by the disposed wastes. Four locations that were estimated to result locally in minimum internal dose to the public were selected on the assumption of 0.1 Ci/y leak of ^{90}Sr. Among the four locations, that which would expose the public to the smallest internal dose was estimated to be lower than 10^{-50} mrem/y. The method of selection of the optimum locations is concluded to be reasonably promising for the solution of present problems of the site selection for a ground disposal site. A point-rating chart is proposed for rapid comparison of the safety of sites by evaluating each location with reference to eighteen factors. The use of this point-rating chart is explained. (auth)

Handling Equipment and Procedures

13405 (ARH-SA-156) CRITICALITY PREVENTION BY CONTINUOUS NON-DESTRUCTIVE INSTRUMENTATION ASSAY IN THE PLUTONIUM RECLAMATION FACILITY. Bruns, L. E. (Atlantic Richfield Hanford Co., Richland, Wash.). 1973. Contract AT(45-1)-2130. 5p. (CONF-730611-10). Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Critical mass prevention is the number-one priority in the safe operation of the Plutonium Reclamation Facility (PRF), a plutonium scrap recovery facility operated by the Atlantic Richfield Hanford Company for the Atomic Energy Commission. The PRF uses geometrically favorable equipment wherever possible, however, added assurance is attained by monitoring the plutonium inputs, outputs and inventories by continuous or semi-continuous instrumentation. The daily throughput is as high as 50 minimum critical masses per day, and the running process inventory is of a similar magnitude; therefore, every precaution must be taken to prevent a critical mass excursion. Nondestructive type instrumentation is used to assay each scrap package

before it enters the process, and NaI single-channel analyzers are used to note inventory buildups. Also, continuous specific gravity and nitric acid concentration instruments help assure low plutonium losses to the waste system. Both gamma and neutron monitors are used to measure plutonium content of waste streams and waste tanks. A simplified sketch of the PRF and its instrumentation for critical mass prevention is shown. Another diagram shows how inventory buildup within the reflux solvent extraction system is monitored by neutron counters. (TFD)

13406 (BNWL-SA-4591) APPLICATION OF PULSED NEUTRON SOURCE TECHNIQUES TO PLANT SYSTEMS. Bierman, S. R.; Clayton, E. D. (Battelle Pacific Northwest Labs., Richland, Wash.). Jun 1973. Contract AT(45-1)-1830. 22p. (CONF-730611-11). Dep. NTIS $3.25.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Pulsed neutron source measurements can be used to determine the degree of subcriticality of certain types of operating plant systems. Measurements made on laboratory systems have established confidence that data can be gathered and analyzed correctly, but that measurements are not always possible on systems having a high neutron background or a high neutron energy distribution. Measurements made on systems in plant facilities have yielded what are considered to be reasonable answers, and have varied from a few dollars subcritical to over a hundred dollars subcritical. Additional experience is needed on plant systems having odd or interacting geometries and which exhibit spatial dependencies. (auth)

13407 (RFP-2034) CRITICALITY CALCULATIONS FOR PLUTONIUM NITRATE SOLUTIONS. Dickinson, D. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 9 May 1973. Contract AT(29-1)-1106. 4p. Dep. NTIS $4.00.

Number density formulas for plutonium nitrate solutions are derived with the use of an empirical formula for the water content of such solutions. The number densities given by those formulas are compared with those for actual solutions, and the effect of differences in number densities on critical dimensions is examined. Finally, the critical radii for bare spheres of plutonium solution are calculated. (auth)

13408 CRITICALITY PROBLEMS AND SOLUTIONS IN NUCLEAR SAFEGUARDS. Smith, D. B.; Foley, J. E. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 146(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13409 CRITICALITY PREVENTION BY CONTINUOUS NONDESTRUCTIVE INSTRUMENTATION ASSAY IN THE PLUTONIUM RECLAMATION FACILITY. Bruns, L. E. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 147-148 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13410 CRITICALITY SAFETY DETERMINATION BY PULSED-NEUTRON SOURCE TECHNIQUES. Bierman, S. R.; Clayton, E. D. (Battelle-Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 148-149(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13411 IN SITU MEASUREMENTS TO ASSURE CRITICALITY SAFETY DURING CASK LOADING OF BAWTR FUEL ELEMENTS. Baldwin, M. N.; Shah, N. H. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 16: 149-150(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13412 ICPP SOLUBLE POISON METER. Georgeson, M. A.; Morrison, W. G. (Allied Chemical Corp., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 16: 150-151(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13413 PASSIVE GAMMA, NEUTRON MONITOR FOR FISSILE MATERIAL IN SCRAP AND WASTE. Goris, P. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 151-152(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13414 EXPERIMENTAL PROGRAMS AT THE DOW ROCKY FLATS NUCLEAR SAFETY LABORATORY. Schuske, C. L. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 16: 157-158(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13415 CRITICAL MASS LABORATORY PROGRAM IN FRANCE. Lecorche, P. R. (CEN de Saclay, Gif-sur-Yvette, France). Trans. Amer. Nucl. Soc.; 16: 158-159(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13416 EXPERIMENTAL CRITICALITY IN THE UNITED KINGDOM. Chalmers, J. H. (Nuclear Installations Inspectorate, Liverpool). Trans. Amer. Nucl. Soc.; 16: 160-161(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-620611-.

13417 CRITICAL LATTICE DATA IN SUPPORT OF SAFE FUEL HANDLING CRITERIA. Lacey, P. G. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 161(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13418 SUMMARY OF MEASUREMENTS NEEDED FOR NUCLEAR CRITICALITY SAFETY: AN INDUSTRIAL POINT OF VIEW. Artigas, R. (General Electric Corp., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 161-163(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13419 CRAC EXPERIMENTAL STUDY OF CRITICALITY ACCIDENTS. Lecorche, P. R. (CEN de Saclay, Gif-sur-Yvette, France). Trans. Amer. Nucl. Soc.; 16: 163-164(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13420 CRITICALITY ANALYSES FOR THE FFTF INTERIM DECAY STORAGE FACILITY. Bunch, W.; Marr, D. R. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 284(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13421 SURVEY OF PROCESS EQUIPMENT FOR CRITICALITY SAFETY ON A PERIODIC BASIS TO DETERMINE PLUTONIUM BUILDUP. Slind, M. T. (Atlantic Richfield Hanford, Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 150(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13422 PACKAGING FOR THE TRANSPORT AND STORAGE OF RADIOACTIVE MATERIALS. Blum, P. (to Transnucleaire). French Patent 2,124,064. 22 Sep. 1972. Filed date 2 Feb 1971. 11p. (In French).

Modifications to packaging for transporting and storing radioactive materials are presented. The packaging consists of several internal containers or capsules housing the radioactive material, γ-ray shielding and an external container filled with water in which the shielding and capsules are immersed. The internal containers or capsules are connected at their upper ends by fixing them to a plate provided with fixing holes and forming a peripheral flange. The capsules can be closed and sealed with movable lids operating in conjunction with the plate. The capsules are connected together at their bottom ends by a structure similar to that connecting their upper ends, this structure functioning in conjunction with a common movable base. The lid and the movable base connecting the capsules are provided with a hollow structure reinforced by ribs positioned opposite the elements of the plate joining two neighboring capsules, the lid and the base being provided with a peripheral flange which presses against the periphery formed by the plate joining the capsules. (FR)

13423 MODELS FOR THE SAFE STORAGE OF DRY AND WET FISSILE OXIDES. Schuske, C. L.; Altschuler, S. J. (Dow Chemical Co., Golden, CO). Nucl. Technol.; 19: No. 2, 84-95 (Aug 1973).

A model has been developed for calculating critically safe storage arrays of cylindrical vessels containing water/fissile oxide mixtures of PuO_2 (96% ^{239}Pu and 4% ^{240}Pu) or UO_2 (93.4% ^{235}U and 6.6% ^{238}U). It was assumed that these arrays were in air surrounded by a 12-in.-thick concrete vault. This model uses the concepts of surface density and unit surface-to-volume ratio to define safe array parameters. The model handles fissile densities ranging from that of the theoretical crystal down to ~1 kg/liter and containers whose shapes range from 300-cm-high thin cylinders to flat slab-shaped containers. Correction factors for dry oxide storage at various densities have also been developed for the cases where water can be prevented from entering the oxide containers. A considerably greater weight of oxide can be stored when water can be precluded. The effect of several inches of water on the concrete floor lowers k_{eff} ~3%. (The units are assumed to be at least 12 in. above the floor.) (auth)

Transportation

13424 (DPSPU-72-124-3) SAFETY ANALYSIS REPORT, PACKAGES SRL 4.5-TON CALIFORNIUM SHIPPING CASK (PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS). Final Report. Whatley, V. Jr.; Mahoney, D. J. (comps.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Jul 1973. Contract AT(07-2)-1. 72p. Dep. NTIS $5.75.

A shielded cask especially designed for shipping californium-252 neutron sources is basically a spherical steel shell filled with water-extended polyester as the shielding material. The cask complies with requirements for shipping "large quantities" of radioactive materials as described in AEC Manual, Chapter 0529, "Safety Standards for Packaging of Radioactive and Fissile Materials." The cask also complies with IAEA "Regulations for the Safe Transport of Radioactive Materials," 1967 Edition. Normal and accident conditions of transport are withstood without release of ^{252}Cf. (auth)

13425 IMPROVED MODEL FOR SPENT-FUEL TRANSPORTATION RISKS. Yadigaroglu, G.; Reinking, A. G. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 16: 39-40(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13426 LICENSING OF PACKAGES FOR THE TRANSPORT OF RADIOACTIVE MATERIALS. MacDonald, C. E.; Odegaarden, R. H. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 173(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13427 NFS-4 SPENT-FUEL SHIPPING CASK. Barnhart, V. J. (Nuclear Fuel Services, Inc., West Valley, NY); Rollins, J. D. Trans. Amer. Nucl. Soc.; 16: 174(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13428 SPENT-FUEL SHIPPING EXPERIENCE: YANKEE ATOMIC ELECTRIC COMPANY. Tarmuzzer, E. C. (Yankee Atomic Electric Co., Westboro, MA). Trans. Amer. Nucl. Soc.; 16: 174-175(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 13953 and 14061.

13429 (JINR-P7-7092) ACCELERATION OF GE IONS IN JINR CYCLOTRONS. Tret'yakov, Yu. P.; Zager, B. A.; Shelaev, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The four- and five-charge Ge ions are accelerated in the Y-300 cyclotron (JINR) from the multiply charged ion source with cathode sputtering of the working substance. The Ge_{74}^{3+} ion beam is directed into the Y-200 cyclotron where Ge_{74}^{3+} ions are accelerated up to 8.2 MeV/nucl energy after stripping with a carbon foil. The maximum intensity of the ion beam at the final radius of the Y-200 cyclotron is equal to 10^{10} part/sec. (auth)

13430 (SLA-73-5275) ^{16}O CONTAMINATION IN ^{4}He ANALYSIS BEAMS. Picraux, S. T.; Borders, J. A.; Langley, R. A. (Sandia Labs., Albuquerque, N. Mex.). 1973. 18p. (CONF-730632-2). Dep. NTIS $3.00.

From international conference on ion beam surface layer analysis; Yorktown Heights, New York, USA (18 Jun 1973).

The $^{4}He^{+}$ beam from a Van de Graaff accelerator is often accompanied by an $^{16}O^{+}$ beam of the same energy. If after acceleration and before magnetic analysis, one electron is stripped from the oxygen ion to form $^{16}O^{2+}$, these ions will not be separated from $^{4}He^{+}$ during magnetic analysis. The $^{16}O^{2+}$ fraction in the $^{4}He^{+}$ beam was measured by analyzing backscattering spectra for a thin Au film and the O to He ion charge ratio of 2 : 1 was confirmed by electrostatic deflection. Ion source conditions and the pressure in the beam lines strongly affect the $^{16}O^{2+}$ fraction and the dependence of the O^{2+}/O^{+} ratio on pressure is found to be in approximate agreement with predicted values. A formula for estimating the $^{16}O^{2+}$ beam intensity, based on charge exchange data and measurement of the primary $^{16}O^{+}$ beam intensity, is $N_{[O^{2+}]} = 13\ P(\text{torr})\ l(\text{cm})\ N_{[O^{+}]}$, where P is the total gas pressure, l is the length of the beam line between the accelerator and switching magnet, and $N_{[O^{2+}]}$ and $N_{[O^{+}]}$ are the beam intensities of the respective species. The $^{16}O^{2+}$ contamination of $^{4}He^{+}$ beams is easily removed by electrostatic separation. (auth)

Auxiliaries and Components

Refer also to abstracts 13954 and 14098.

13431 (BNL-17919) DIAGNOSTIC STUDIES OF MP ACCELERATION TUBE FAILURE. Wegner, H. E. (Brookhaven National Lab., Upton, N. Y.). 1973. 28p. (CONF-730530-3). Dep. NTIS $3.50.

Four of the eight two-meter long acceleration tube sections were removed from the MP accelerator that is used for the final two stages of acceleration in three-stage operation or as a conventional two-stage tandem accelerator. These tubes had been in service approximately 15,000 hours and had been used predominantly for the acceleration of heavy ions. The sections removed were the two immediately before and immediately after the high voltage terminal, tube sections #3, #4, #5, and #6. The manner in which the tubes failed were studied in detail and various kinds of close-up and semi-micro photographs were obtained that show the mechanism of catastrophic failure leading to glass fracture. This failure is initiated by production of a tree-like growth inside the insulating glass section resembling the classical Lichtenberg-type figures produced in plastics by excess electron discharge. These tree figures produce microcracks which gradually spread and result in a major glass fracture which causes that particular glass section to fail completely in voltage-holding capability. Possible mechanisms for this effect as well as possible solutions for its cure are suggested. (auth)

13432 (LA-5013-T) STATE ESTIMATION IN DISCRETE-TIME LINEAR SYSTEMS WITH QUADRATIC FORM OBSERVERS. Shipley, J. P. Jr. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 148p. Dep. NTIS $5.45.

Thesis. Submitted to Univ. of New Mexico, Albuquerque.

The problem of estimating the state of a system with a linear plant equation but having a measurement function which is a quadratic form in the state is considered. It is first demonstrated by constructive proof that the problem has a solution if the controls have large enough magnitude, and some requirements on the minimum size of the control are discussed. Three algorithms for estimating the state are obtained, one using the technique of maximum likelihood, the other two utilizing a more general Bayesian approach. In addition, a first-order approximate conditional mean filter is included for comparison. It is demonstrated by structural comparisons and numerical results that the algorithm for finding an approximate maximum of the posterior density function is the overall best in terms of speed, storage, practicability, and accuracy. It is also shown that good state estimates can be generated for a large class of problems using any of these algorithms if the control largeness conditions are satisfied. Finally, some extensions are discussed, the main one being the application of the technique of finding an approximate maximum of the posterior density function to systems with more general nonlinear observers. The problem originated with the beam control problem at the LASL Van de Graaff. The original task was to focus and position the beam using only a Faraday cup. The results obtained may be useful in any situation where a beam must be positioned based on only a measurement of the beam from a reference point. (auth)

13433 SHIELDING CALCULATIONS FOR A 400-MeV ELECTRON ACCELERATOR. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 334-335 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13434 IMPROVEMENTS TO A METHOD OF EXTERNALLY PULSING AN ACCELERATOR. Ramos, A. G.; Cooper, P. N. (Univ. of Aston, Birmingham). Nucl. Instrum. Methods; 109: No. 3, 617-618(1973).

A simplified method of producing a square beam current waveform from a SAMES 150 kV accelerator has been devised. Square light pulses are transmitted to the high voltage terminal by an optical link using semiconductor devices. The transmitted signal controls a high voltage power transistor which extinguishes the ion source rf when in the conducting state. Operating frequencies are from 1 Hz to 2 kHz. (auth)

13435 ABSOLUTE MEASUREMENT OF ACCELERATOR BEAM ENERGY BY THE TIME-OF-FLIGHT TECHNIQUE. Mak, H. B.; Jensen, H. B.; Barnes, C. A. (California Inst. of Tech., Pasadena). Nucl. Instrum. Methods; 109: No. 3, 529-532(1973).

A simple time-of-flight technique for measuring absolute beam energy is described. A precision of better than 0.03% in energy was obtained easily, and several obvious improvements are suggested which should yield a precision of better than 0.01%. (auth)

Ion Sources and Injection and Extraction Systems

13436 BEAM QUALITY MEASUREMENTS FOR HYDROGEN AND NITROGEN IONS FROM A CYCLOTRON ION SOURCE. Toman, M. P. College Park, MD; Univ. of Maryland (1972). 103p. University Microfilms Order No. 73-13,642.

Thesis (Ph. D.).

In an increasing number of applications today, an ion source of excellent beam quality (high current density and low emittance) is required. Thus, information leading to a deeper understanding of the mechanisms of behavior of an ion source is critical. The ion source test facility used is one of the few facilities in the world designed to make beam quality measurements of a cyclotron ion source. The purpose of this research was to understand in more detail some of the mechanisms of ion source behavior for protons, molecular hydrogen, and nitrogen ions. Experimental data was taken of the radial density profiles of H^{+}, H_2^{+}, and H_3^{+} ions at different magnetic fields, accelerating potentials, and ion source operating conditions. The effects of emittance, space charge, and external focusing forces on the beam envelope were analyzed theoretically. Systematic measurements of the radial width versus the beam current and the dee voltage generally confirmed theoretical expectations. The unusual behavior of the beam at a particular set of conditions could be related to a plasma oscillation/cyclotron resonance of the electrons in the arc. Radial density profile measurements were also made for N^{+} and N^{2+} beams. In addition,

the radial emittance and luminosity for N^+ and N^{2+} beams were measured for different accelerating voltages. The emittance was found to suggest a strong charge state dependence. The N^{2+} beam always had a smaller emittance than the N^+ beam. This difference was partly explained by the larger velocity of the N^{2+} ions. (Diss. Abstr. Int., B)

Ion Optics and Field Calculations

13437 (BNL-17896) LUMINOSITY FOR UNBUNCHED BEAMS IN THE ISA. Month, M.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 16 May 1973. 18p. Dep. NTIS $3.00.

The determination of the luminosity is based on a set of superimposed constraints. One must consider, for example, the beam-beam tune shifts, including the long range contributions, the amount of free space around the crossing point (related to the maximum allowable β-value consistent with lattice stability), the collision interaction length, and the limitations on particle line density due to single beam phenomena. Because of the many constraints, the determination of the accelerator parameters giving a design luminosity must be the result of a complex optimization process. A simplified treatment is given here. Assuming rectangular, uniform density, unbunched beams, a simplified optimization is performed. A few examples of sets of design parameters are given. (auth)

13438 (BNL-17906) RANDOM ERROR MULTIPOLES IN COSINE MAGNETS. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). 10 May 1973. 5p. Dep. NTIS $3.00.

The analytical results for the random error multipoles generated by random errors in the current block positions are summarized and compared with the results of exact computer calculations. Bending magnets and quadrupoles are considered. Results are given for magnets having a 4-in. aperture and for a random error in the current block positions of 0.002 in. (auth)

Experimental Facilities

Refer also to abstract 14102.

13439 FACILITY FOR FAST NEUTRON TIME OF FLIGHT EXPERIMENTS. Crawford, G. I.; Hall, S. J.; McKeown, J.; Kellie, J. D.; Smye, D. B. C. B (Univ. of Glasgow). Nucl. Instrum. Methods; 109: No. 3, 479-491(1973).

Nuclear reaction experiments involving neutrons as primary or secondary particles have been performed on a multi-angle time of flight spectrometer with an electron linear accelerator source. Essential features in the design of a flexible arrangement with good resolution are discussed, and examples are given to illustrate the quality of the experimental results. (auth)

13440 ROTATING TARGET HOLDER FOR LOW MELTING POINT NUCLEAR TARGETS. Woodburn, E. H.; Barrette, M.; Foster, J. L. Jr.; Lamoureux, G. (Univ. of Montreal). Nucl. Instrum. Methods; 109: No. 3, 561-563(1973).

Using a ferromagnetic feedthrough a simple rotating target holder has been constructed for an Ortec 600 series scattering chamber. In actual measurements we obtained significant improvement in the maximum beam current, which a selenium target could tolerate. (auth)

13441 PREPARATION AND UTILISATION OF MERCURY TARGETS FOR MEASUREMENTS WITH HEAVY ION BEAMS. Doubt, H. A.; Fechner, J. B.; Hagemeyer, K.; Speidel, K. H. (Univ., Bonn). Nucl. Instrum. Methods; 109: No. 3, 571-572 (1973).

The techniques used to obtain stable, uniform HgS targets up to 1 mg/cm^2 thick and to employ them in-beam are described. (auth)

13442 OPTIMUM THICKNESS OF TRITIUM–TITANIUM TARGETS FOR THE 150 keV DEUTERONS. Kabir, S. M. (Univ. of Aston in Birmingham, Eng.). Nucl. Instrum. Methods; 109: No. 3, 533-536(1973).

On the basis of variable tritium distribution in the tritium-titanium targets and their behaviour in the low energy accelerators, the optimum thickness for the production of 14 MeV neutrons, has been worked out; this is in the range of 4 mg/in.^{2} to 5 mg/in.^{2} of titanium or 16,000 to 20,000 Å thick tritated titanium. Use of optimum thickness gives higher yield and longer life to the targets; also the uncertainty in the computed alpha-to-neutron anisotropy factor becomes minimum. (auth)

13443 CRYOGENIC SYSTEM FOR LOW-TEMPERATURE AND CLEAN ENVIRONMENT CHANNELING MEASUREMENTS. Boettinger, J.; Davies, J. A.; Lori, J.; Whitton, J. L. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucl. Instrum. Methods; 109: No. 3, 579-583(1973).

An experimental apparatus is described for studying channeling in a clean environment at temperatures as low as 25 K. The target is mounted on a standard 2-axis goniometer and is almost completely surrounded by a large cryoshield at 20 K. This cryoshield reduces the build-up rate of carbon and oxygen contamination on the surface to less than 5×10^{14} molecules/cm^2. For low-temperature measurements, the target is connected by a length of copper braid to the refrigerator system. Some preliminary measurements at 25 K and at 300 K are presented. (auth)

13444 APPLICATION OF A GAS JET RECOIL TRANSPORT SYSTEM TO THE PRODUCTS OF FAST NEUTRON REACTIONS. Weisehahn, W. J.; Dautet, H.; D'Auria, J. M.; Pate, B. C. (Simon Fraser Univ., Burnaby, Canada). Nuclear Instruments and Methods; 109: No. 3, 613-614(1973).

A gas jet recoil transport system has been applied successfully to the transport of radioactive products from 14-MeV neutron induced reactions on Al, Mg and Cu targets. Using ethylene gas as the carrier, these products were transported distances of 30 m with an efficiency of at least 36% and a measured transit time of 1.6 ± 0.3 s. (auth)

13445 ELECTRON LINEAR ACCELERATORS FOR RADIATION THERAPY. History, Principles, and Contemporary Developments. Karzmark, C. J.; Pering, N. C. (Stanford Univ., CA). Phys. Med. Biol.; 18: No. 3, 321-354(May 1973).

The use of electron linear accelerators for radiotherapy is broadly reviewed with extensive literature references. The subject is discussed under the following headings:- (1) introduction and history; (2) microwave cavity, power generation, travelling wave accelerating structures, and standing wave accelerating structures; (3) radiotherapy treatment units, isocentric mounting, auxillary systems (vacuum, beam transport, electronics), operating parameters and performance, radiation monitoring and safety features, chronological review of treatment units; and (4) contemporary developments, including computer control, monitoring and record keeping, cryogenic accelerators with superconducting cavities, and microtrons. (UK)

13446 FURNACE OF HIGH ACCURACY AND VERSATILITY FOR NEUTRON SCATTERING EXPERIMENTS ON SOLIDS AND LIQUIDS UP TO 1100°K. Kunsch, B.; Eder, O. J.; Schwara, R. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). J. Phys., E (London); 6: No. 6, 576-578(Jun 1973).

A vacuum furnace for neutron scattering experiments on solids and liquids up to 1100°K is described. Cyclic interchanging of the three positions (heated sample, heated empty container and a vanadium standardizing sample) leads to ready calibration and accurate data normalization. Principal features of the design are high versatility and adaptability to various types of spectrometers. The sample temperature can be maintained to within ±0.3 K for 24 h and the axial gradient in the sample (liquid aluminium) is ±0.15 K over 50 mm at 1020 K. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

13447 RADIAL PULSATIONS AND DYNAMICAL INSTABILITY OF RELATIVISTIC SPHERES. Kuchowicz, B. (Univ., Warsaw). Lett. Nuovo Cim.; 7: No. 9, 341-344(30 Jun 1973).

The Chandrasekhar analysis of dynamical stability is extended to arbitrary coordinate systems. The second variation of the action for a dynamical system consisting of a perfect fluid and of the gravitational field is considered. The theory is useful for relativistic astrophysics. (JFP)

Cosmic Radiation

Refer also to abstract 13659.

13448 NEW DATA ON THE COSMIC HISTORY OF THE SIKHOTE–ALIN METEORITE. Kolesnikov, E. M.; Lavrukhina, A. K.; Levskii, L. K.; Fisenko, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 6, 1300-1302(21 Dec 1972). (In Russian).

The radiation ages of six specimens of the Sikhote-Alin' meteorites were investigated by the $^{39}Ar-^{38}Ar$ method, obtaining a range of values from 68 to 550 millions of years. The discussion of these age values was aided by a family of curves representing the formation rate of ^{38}Ar as a function of the distance from the center of a meteorite. (KSW)

13449 INTERPRETATION OF THE CHARGE RATIO OF COSMIC RAY MUONS. Hume, C. J.; Nandi, B. C.; Thompson, M. G.; Whalley, M. R.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 6, L73-L76(Jun 1973).

An examination is made of the charge ratio of near vertical cosmic ray muons at energies up to 2×10^{12} eV in the light of recent accelerator results. The results can be understood if the charge ratio of pions emitted with energy in the region of 20% of the primary proton energy is smaller for p–air nucleus than has been measured for p–p interactions. This result appears to contradict the strict application of the fragmentation hypothesis. (auth)

13450 ELECTRON COMPONENT OF LARGE EAS. Armitage, M. L.; Blake, P. R.; Nash, W. F. (Univ. of Nottingham, Eng.). J. Phys., A (London); 6: No. 6, 886-891(Jun 1973).

A large-area neon flash-tube detector has been used to measure the density of electrons occurring in EAS detected at Haverah Park for shower size $0.29 < \rho_{500} < 1.7$. Comparison of the total charged particle lateral density distribution with that of the muon component is made. The response of the flash tubes is also compared with that from neighbouring 1.2 m deep water Cherenkov tanks. (auth)

13451 LATERAL DISTRIBUTION OF MUONS IN NEAR VERTICAL EAS. Armitage, M. L.; Blake, P. R.; Nash, W. F. (Univ. of Nottingham, Eng.). J. Phys., A (London); 6: No. 6, 878-885 (Jun 1973).

A large-area muon detector (12.5 m^2) has been used to investigate the muon component of large EAS at Haverah Park of size $0.27 < \rho_{500} < 2.5$ for zenith angle $(\theta) < 25°$. The analysis is based on 821 showers covering core distances of 160 m to 500 m. The results are compared with other observations and with recent model calculations. It is found that only certain models are in reasonable agreement with the experimental data. (auth)

13452 CALCULATIONS ON THE RADIO EMISSION RESULTING FROM GEOMAGNETIC CHARGE SEPARATION IN AN EXTENSIVE AIR SHOWER. Hough, J. H. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 6, 892-900(Jun 1973).

Calculations have been made of the radio emission resulting from the separation of extensive air shower electrons and positrons in the geomagnetic field. Frequency spectra and lateral distributions of the radiation are presented for showers developing at different heights in the atmosphere. (auth)

13453 COMPOSITION OF GALACTIC COSMIC RAYS WITH $30 < E < 100$ MeV/NUCLEON. O'Sullivan, D. (Dublin Inst. for Advanced Studies); Thompson, A.; Price, P. B. Nature (London) Phys. Sci.; 243: No. 123, 8-9(7 May 1973).

With a view to studying the chemical composition, energy spectra, and origin of interplanetary heavy ions a stack of track recording plastic detectors was exposed outside the Apollo 16 lunar module. Particles with $E > 30$ MeV/N are discussed, and it is shown that they are of galactic origin. It is stated that the measurements are the first to be made at energies below ~150 MeV/N on elements as heavy as Fe, and are particularly interesting in the light of recent observations that the composition of cosmic rays changes with energy over the interval ~2 to ~70 GeV/N. Details of the experimental technique and data analysis are given. Fe and Si peaks are easily recognizable in the data. Abundance ratios are shown tabulated. A strong case is indicated that most interplanetary particles of $\gtrsim$30 MeV/N are of galactic rather than solar origin. The shape and magnitude of the spectrum for $23 \leq Z \leq 28$ appeared to be reasonably consistent with what would be expected if the composition is independent of energy. Results can be taken as supporting evidence that cosmic rays in the inner solar system with energies <100 MeV/N have suffered adiabatic deceleration from energies of several hundred MeV/N before entering the solar system. At ~100 MeV/N the cross section for fragmentation of Fe into Mn and Cr rises to several hundred millibarns and the ratio (Mn + Cr)/Fe would be expected to increase accordingly for cosmic rays that had that energy outside the solar system. (UK)

13454 GAMMA-RAY OBSERVATIONS OF THE GALACTIC CENTRE. Helmken, H. F.; Hoffman, J. A. (Smithsonian Astrophysical Observatory, Cambridge, MA). Nature (London) Phys. Sci.; 243: No. 123, 6-8(7 May 1973).

A pointable gas-Cherenkov γ-ray telescope was balloon flown from Parana, Argentina, in order to investigate γ radiation from the galactic center. The detector was sensitive to γ rays >10 MeV, and carried a γ-ray conversion scintillator with an area of 4×10^3 cm^2. Details are given of the experimental technique adopted. The results indicated a 3.8 σ excess of γ radiation from the direction of the galactic center over background. Both point source and line source radiation models were used in analysing the data. Cosmic-ray interactions with galactic H can produce the observed galactic plane γ radiation by pion decay, and the excess γ radiation from the galactic center region could be from increased cosmic ray or H densities, or from another source, such as electrons scattering from the infrared radiation field. Cosmic-ray electrons have been suggested as the source of the extra γ radiation, but this hypothesis can be checked only by measuring the γ-ray spectrum down to low energies. The present results, to within statistical accuracy, require the presence of a Compton scattered γ-ray flux from the galactic center in addition to pion decay γ rays. Studies by other workers are also briefly summarized. (UK)

13455 CONTRIBUTION OF PION PRODUCTION BY PRIMARY COSMIC-RAY NUCLEONS TO THE INTERSTELLAR ELECTRON-POSITRON FLUX. Dooher, John (Research Department, Grumman Aerospace Corporation, Bethpage, New York 11714). Phys. Rev. D 7: No. 5, 1406-1411 (1 Mar 1973).

The secondary electron–positron component of high–energy cosmic radiation is calculated. Using the Feynman scaling law for the inclusive pion distribution function, it is shown that the secondary positron–electron component will have the same power law as the primary electron component if the proton and electron injection spectra are the same. Numerical estimates are made using an appropriate fit of the pion single–particle distribution function to accelerator data. The π^0–γ–ray component is also discussed. (auth)

13456 COSMIC RAYS. Peters, B. (Danish Space Research Inst., Copenhagen). pp 327-338 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

Methods of detection and identification of cosmic-ray particles are described. The effect on them of the geomagnetic field before they enter the atmosphere and of solar modulation are discussed. Solar and galactic cosmic rays are treated separately and the isotropy, energy spectrum, and chemical and isotopic composition of the latter discussed. The propagation of cosmic rays in the Galaxy, their age, and possible sources are described. The secondary cosmic rays in the atmosphere are briefly treated and the use of cosmic-ray activation products as radioactive tracers is considered. (NO)

13457 UPPER LIMIT OF THE ANTINUCLEAR CONTENT OF PRIMARY COSMIC RAYS. Ivanova, N. S.; Kulikov, V. N.; Yakubovskii, E. A. Kosm. Issled.; XI: No. 1, 163-165(1973). (In Russian).

Data were collected from various authors on the upper limit of the antinucleus content of cosmic rays and compared with experimental work of the authors. Other workers have failed to allow for corrections for the difference in cross sections of interaction of nuclei and antinuclei in emulsion. The data collected indicated that the accuracy of the determination of the upper limit of the antinucleus content in the present work significantly exceeds (al-

most by an order of magnitude) that of all previous work. (KSW)

13458 DIRECT MEASUREMENT OF THE MAGNETIC RIGIDITY SPECTRA OF COSMIC RAYS. Adams, J. H. Jr. Raleigh, NC; North Carolina State Univ. (1972). 131p. University Microfilms Order No. 73-13,904.

Thesis (Ph.D.).

The differential magnetic rigidity spectra of cosmic-ray nuclei from helium to iron were measured from 4.5 GV to 240 GV. The spectra were found to fit power laws with spectral indices of 2.86 ± 0.28 for L nuclei ($3 \leq Z \leq 5$), 2.45 ± 0.12 for M nuclei ($6 \leq Z \leq 9$), and 2.65 ± 0.41 for H nuclei ($Z \geq 10$). All nuclei S ($Z \geq 3$) were also fitted to a power law with a spectral index of 2.53 ± 0.11. An upper limit of 3.9×10^{-3} was set for the ratio of antinuclei to nuclei with $Z \geq 2$ and $P \geq 4.5$ GV. These spectra were measured in the first test of the technique of magnet-emulsion spectroscopy. The results of the experiment show that the technique is a powerful tool of cosmic-ray research. It is capable of measuring magnetic rigidity spectra and charge ratios to 10^4 GV. (Diss. Abstr. Int., B)

Stars

13459 PERIOD DETERMINATION OF A VARIABLE STAR. Todoran, I. (Astronomical Observatory, Cluj). Stud. Cercet. Astron.; 18: No. 1, 37-46(1973).

A peculiar case of period determination is examined. It is shown that Lafler-Kinman, Deeming, and Jurkevich's methods which avoid interpolation in the light curves, could not be applied with maximal efficiency in all practical cases, especially when only a small number of observations is available. A new method is proposed which, although it makes use of interpolation in the light curves, can also be applied when the number of observed branches of a light curve is not big. This new method is illustrated by two numerical examples. (auth)

13460 NON-LINEAR PULSATIONS OF UPPER MAIN SEQUENCE STARS. 2. Direct Numerical Integrations. Papaloizou, J. C. B. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 169-187(1973).

The nonlinear pulsations of vibrationally unstable main-sequence stars of between 70 and 210 $M_\odot$ are studied using numerical methods directly. Nonlinear solutions are investigated for various amplitudes for short periods of time. The results are found to be in qualitative agreement with those obtained in a previous paper using a perturbation technique. The results are found to be different from those given by other authors. In particular no mass loss is found. Possible reasons for the discrepancy are given. (auth)

13461 NON-LINEAR PULSATIONS OF UPPER MAIN SEQUENCE STARS. 1. A Perturbation Approach. Papaloizou, J. C. B. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 143-168(1973).

The nonlinear pulsations of vibrationally unstable main-sequence stars of between 70 and 170 $M_\odot$ are investigated using a perturbation technique, prior to using numerical methods directly in a subsequent paper. More general as well as periodic solutions are considered. It is found that the presence of resonances results in overtone involvement which causes systematic modulation of the velocity curve and leads to the possibility of limitation at fairly low values of the amplitude. Consideration of the behaviour close to resonance is given and the relationship of the periodic solutions to more general solutions discussed. (auth)

13462 COMPUTER PROGRAMS IN ASTROPHYSICS. Thomas, H. C. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Comput. Phys. Commun., Suppl.; 3: 151-156(Sep 1972).

Applications of computers in the areas of stellar structure and evolution, galactic structure, cosmology, quasars, pulsars the sun, and planetary phenomena are discussed. (WDM)

13463 ECLIPSING BINARY RT ANDROMEDAE. Dumitrescu, A. (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 18: No. 1, 47-62(1973). (In Rumanian).

During the period October 1 – 8, 1971 three light curves (in V only) were obtained. The observations were performed at Ondřejov Observatory, using the 65 cm Cassegrain telescope. There is an evidence of variability of form of the light curve from night to night. (auth)

13464 PHOTOMETRIC STUDY OF THE PULSATING STAR BE ERIDANI. Pop, V.; Todoran, I. (Astronomical Observatory, Cluj). Stud. Cercet. Astron.; 18: No. 1, 67-71(1973). (In Rumanian).

From 355 photographic observations of BE Eridani 14 Epochs of maxima were determined. The differences $(O-C)_1$ and $(O-C)_2$ were computed. Blazhko's effect was obvious with a period $\pi = 94$ P. According to the shape of the light curve BE Eridani belongs to RR Lyrae stars of type RR_{ab}. (auth)

13465 POSSIBILITY OF DETERMINING STELLAR RADIAL VELOCITIES TO 0.01 km s^{-1}. Griffin, R.; Griffin, R. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 243-253 (1973).

Dissimilarities in the illumination of spectrographs by star light and by comparison sources, respectively, normally prevent the realization of radial-velocity accuracies anywhere near those which high-resolution spectrographs ought to provide. These difficulties can be entirely circumvented by the use of telluric absorption lines as the stationary comparison source. There seems to be no reason, if the appropriate and possible precautions enumerated in this paper are taken, why radial velocities accurate to 10 m s^{-1} should not be achieved for a restricted selection of stars. Existing spectrograms, taken for other purposes and without the benefit of any special precautions, already show an accuracy well in advance of normal standards. (auth)

13466 ATMOSPHERE OF EPSILON LEONIS. Williams, P. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 235-242(1973).

Using model atmospheres and high dispersion (2.2 Å mm^{-1}) spectrograms observed with the Isaac Newton Telescope, the Go II type giant ϵ Leonis is analyzed relative to the Sun and ϵ Vir. It is found to have a solar-type composition, but a significantly higher microturbulence (2.6 km s^{-1}) than either ϵ Vir (1.8 km s^{-1}) or the Sun (assumed to have zero microturbulence). (auth)

13467 PHOTOMETRY OF SOUTHERN GLOBULAR CLUSTERS. 2. Bright Stars in NGC 6752. Cannon, R. D.; Stobie, R. S. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 227-234(1973).

Photoelectric UBV data are presented for nearly 100 stars with $V \leq 16$ in NGC 6752. The cluster has reddening $E(B-V) = 0.05$ mag and distance modulus $(m-M) \approx 13.5$. The cluster giant branch shows a clear separation into "normal" and "asymptotic" branches, although the latter seems to consist rather of a series of clumps. The variation of ultraviolet excess with magnitude along the giant branches agrees with that expected from changes in surface gravity. One new small amplitude red variable has been detected. (auth)

13468 PHOTOMETRY OF SOUTHERN GLOBULAR CLUSTERS. 1. Bright Stars in ω Centauri. Cannon, R. D.; Stobie, R. S. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 207-225(1973).

The techniques used for observing globular cluster stars are described, and several sources of error are discussed. Photoelectric UBV data are presented for 126 stars brighter than V = 16.5 in ω Cen. These data are compared with those of previous photoelectric and photographic studies. There are four principal conclusions. (i) In the colour–magnitude (C–M) diagram the ω Cen giant branch has an exceptionally large scatter, of which only a small part can apparently be due to errors, field stars, and differential reddening. There is no obvious bifurcation of the red-giant branch into normal and asymptotic branches. The large intrinsic scatter may be caused by the presence of normal and asymptotic branches which are then blurred out by a small amount of differential reddening. (ii) The large variation in ultraviolet excess with magnitude which was found by E. H. Geyer (Z. Astrophys.; 66: 16 (1967)) seems to be largely due to errors in his ultraviolet calibration; the variation found here is approximately that predicted from expected changes in surface gravity. (iii) Most of the reddest giants are small-amplitude variables; there may be a boundary between variables and nonvariables at about $(B-V)_0 = 1.5$. (iv) After correction for small (<0.1 mag) systematic errors, the extensive Royal Greenwich Observatory photographic photometry has the RGO quoted accuracy for $V < 15.5$. Several observational programmes are suggested, particularly with a view to confirming that the giant branch scatter is intrinsic. (auth)

13469 MASSES OF CATACLYSMIC VARIABLE STARS. Warner, B. (Univ. of Capé Town). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 189-196(1973).

Masses are derived for the components of 10 short period cataclysmic variable stars. With one exception, the masses of the white dwarf primaries lie in the range 1.2 ± 0.2 $M_\odot$, and are thus approximately three times heavier than isolated white-dwarf stars. (auth)

13470 MAGNETIC FIELDS IN RAPIDLY ROTATING STARS. swaran, M.; De Silva, H. A. B. M. (Ceylon Univ., Pera- a). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 289-293 (1973).

Current opinion is that the sharp line upper main-sequence stars that display magnetic fields are slow rotators rather than pole-on rapid rotators (Cameron). In the case of axially symmetric rapidly rotating theoretical models, where meridian circulation is present and the electrical conductivity of the material is finite, computations with the magnetic Reynolds number having values of order 100 or 1000 have shown that the effect of the circulations would be to amplify the field near the poles while allowing the field lines to penetrate the surface (Maheswaran). When the computed values for the "photospheric" field in this theoretical model are applied to real stars, it is estimated that even a modest initial field of 5 Gauss could be amplified by the circulation so that the component of the field parallel to the line of sight averaged over the visible hemisphere for a pole-on rapid rotator would reach the observable lower limit of 100 Gauss. In the case of stronger circulation the amplification is greater. This raises the question as to why pole-on rapid rotators do not display magnetic fields, provided that they are axisymmetric. It is possible either that rapid rotators lose any flux they might have had before reaching the main sequence or that the values of the electrical conductivity and the circulation velocities are such that the magnetic Reynolds number determined by them is very large near the surface, so that the fields are dragged beneath the surface. (auth)

13471 VIBRATIONAL STABILITY OF A CARBON STAR OF 0.8 SUB SOLAR IN THE COURSE OF A CARBON FLASH. Chanmugam, G.; Noels, A.; Gabriel, M. (Univ., Leige). Bull. Soc. Roy. Sci. Leige; 41: No. 11-12, 694-699(1972). (In French).

Stability towards radial pulsations was investigated in the case of a 0.8 $M_\odot$ star composed initially of 50% carbon and 50% oxygen. The evolutionary phase considered extends from the ignition of carbon burning at the center of the star to the end of the hydrostatic adjustment following upon the carbon flash. In spite of an appreciable increase of the destabilizing effect of the central layers, all the models studied remain vibrationally stable, even at the most violent phase of the flash. However, this corresponds to a minimum value of the damping coefficient. Should neutrino losses be taken into account, the possibility of negative values for this coefficient could not, a priori, be rejected. (auth)

13472 ACCURATE WAVELENGTHS OF STELLAR AND TELLURIC ABSORPTION LINES NEAR LAMBDA 70000A. Griffin, R.; Griffin, R. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 255-260(1973).

Wavelengths of 81 stellar and 150 telluric lines in the range $\lambda\lambda$ 6841 to 7424 Å have been determined from 103a-U spectrograms of Arcturus and Procyon. Random errors are expected to be only 1 or 2 mÅ. (auth)

13473 THEORY OF ROTATING STELLAR SYSTEMS. Agekyan, T. A. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 4, 306-312(1970).

Translated from Astrofizika; 6: No. 4, 559-570(1970).

The equations of stellar motion are obtained for a nonspherical stellar system which is stationary in a regular field. Single-phase stellar systems are discussed, i.e., systems in which the values of the three integrals of motion are the same for all stars. Single-phase systems are possible in which the trajectories are closed in the meridian plane and hence the stars of the system lie on some two-dimensional surface. The form of the third integral of motion is found for the trajectories in such systems. The form of the third integral of motion is valid for every potential field due to a nonspherical stellar system which is stationary in a regular field. Using the third integral of motion one can pass to the equations of state of stellar systems which are stationary in a regular field. (auth)

13474 RADIAL PULSATIONS OF ROTATING WHITE DWARFS WITH GENERAL RELATIVITY THEORY AND NEUTRONIZATION EFFECTS TAKEN INTO ACCOUNT. Vartanyan, Yu. L.; Ovsepyan, A. V. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 4, 331-338(1970).

Translated from Astrofizika; 6: No. 4, 601-613(1970).

The energy method is applied to the study of pulsations of rotating white dwarfs situated near the point of stability loss. Corrections for both general relativity theory and for the neutronization effect, the dependence of the number of protons in the atomic nuclei on density, are taken into account. It is shown that the neutronization effect leads to a lower critical central density of rotating configurations (in fact, two orders of magnitude lower), and that the minimum period of radial pulsations increases threefold. Results of the calculations are shown. (auth)

13475 MAGNETIC FIELD OF ROTATING NEUTRON STARS. Sedrakyan, D. M. (Erevan State Univ.). Astrophysics (Engl. Transl.); 6: No. 4, 339-344(1970).

Translated from Astrofizika; 6: No. 4, 615-624(1970).

The electromagnetic properties of neutron stars (pulsars) were studied. Equations for macroscopic plasma movement in the presence of strong gravitational fields were obtained. It is shown that calculation of the first corrections of the general theory of relativity in the plasma hydrodynamic equilibrium equations and the Maxwell equations for the electromagnetic fields leads to the generation of strong toroidal magnetic fields. The order of magnitude of the rise time and maximum value of these fields was estimated. For a model with central density of $8 \cdot 10^{13}$ g/cm^3 the growth of the magnetic field continues up to 10^9 years, reaching a value of 10^{12} G, while for a central density of $5 \cdot 10^{14}$ g/cm^3 the maximum value of the magnetic field is on the order of 10^{14} G, and is attained in a time period on the order of 10^5 years. (auth)

13476 POLARIMETRIC STUDY OF THE MULTIPLE SYSTEM ADS 4374. Strel'nitskii, V. S. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 4, 345-350(1970).

Translated from Astrofizika; 6: No. 4, 625-635(1970).

Results of photoelectric polarimetry of ADS 4374 components and of three selected areas of the associated nebula M78 are given. The degree of polarization of the two components has an anomalously steep rise in the red region of the spectrum as compared to "normal" interstellar polarization. The polarization of the measured areas of the nebula is radial to M78-B, which must therefore be the principal illuminating star. It is shown that the very marked difference in the directions of polarization of the component is caused by the polarizing action of a very dense dust filament (or globule) which is apparently associated closely with the star M78-B. (auth)

13477 POLARIZATION OF H_β EMISSION IN THE SPECTRUM OF γUMa. Derviz, T. E. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 4, 351-354(1970).

Translated from Astrofizika; 6: No. 4, 637-642(1970).

From spectropolarimetric observations, the degree of polarization in the H_β line was found to be $11 \pm 5\%$. This result may be due to the transverse Zeeman effect. (auth)

13478 MEAN FREE PATH OF A PHOTON IN A SCATTERING MEDIUM. Ivanov, V. V. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 4, 355-367(1970).

Translated from Astrofizika; 6: No. 4, 643-662(1970).

Within the framework of the standard model of the theory of resonance radiation transfer (a two-level atom, total frequency redistribution, a probability of photon survival during scattering λ, and a ratio β between the absorption coefficient in the continuous spectrum and the absorption coefficient at the center of the line which are independent of the coordinates), the author formulates the problem of finding the mean free path $\overline{T}$ of a photon in a planar layer having an optical thickness τ_0. The quantity $\overline{T}$ is expressed in terms of the source function $S(\tau)$ and likewise in terms of the intensity of the emergent radiation. An integral equation is derived whose solution allows $\overline{T}$ to be found for any source distribution without knowing $S(\tau)$ or the intensities of the emerging radiation. In two particular cases (sources concentrated on the boundary, and uniform distribution of the sources) $\overline{T}$ is expressed in terms of generalized X and Y functions, and the asymptotic behavior of $\overline{T}$ for large τ_0 and $1 - \lambda = \beta = 0$ is given. (auth)

13479 MASS–LUMINOSITY RELATION IN MULTIPLE-STAR SYSTEMS. Baranov, A. S. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 4, 372-377(1970).

Translated from Astrofizika; 6: No. 4, 669-681(1970).

A method is presented for estimating the relative masses of components in multiple-star systems. This method is based on a comparison of the statistical average distances of stars of various masses from the geometric center, calculated with the help of a numerical experiment, with the observed values. A mass–luminosity relation is plotted for quintuple and sextuple systems. It proves to be weaker than the similar relation for binary stars, which should be explained by the presence of a significant number of optical components in the systems considered. (auth)

13480 SOFTENING OF RADIATION BY MULTIPLE COMPTON SCATTERING. Terebizh, V. Yu. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 4, 368-371(1970).

Translated from Astrofizika; 6: No. 4, 663-668(1970).

The spectral distribution of photons after multiple scattering by free rest electrons is determined in the nonrelativistic approximation. (auth)

13481 SECOND FLARE-UP OF EZ TAURI. Erastova, L. K. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 4, 380(1970).

Translated from Astrofizika; 6: No. 4, 686-687(1970).

Of seventy plates exposed by Badalyan on the 21" and 40" Schmidt telescopes, estimates were made of the brightness of nine known flare stars in Taurus, with the object of discerning the presence of recurrent flare-ups. The effective observation time was of the order of 31 hours. An intense increase in brightness to m_{pg} = 13.4m was recorded only in the case of EZ Tau. (WDM)

13482 CRITICAL PARAMETERS OF COLD WHITE DWARF WITH AN ACCOUNT OF NEUTRONIZATION. Seidov, Z. F. (Shemakha Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 6: No. 4, 381-382(1970).

Translated from Astrofizika; 6: No. 4, 687-689(1970).

The effect of "neutronization" on the critical parameters of white dwarfs has been discussed by various authors. This problem is taken up again, noting, as Hamada and Salpeter (1961) have done, that there is only one type of nucleus in the interior of the star. The discussion is restricted to the Newtonian theory of gravitation. (WDM)

13483 PLASMA PHYSICS, SPACE PHYSICS, AND ASTROPHYSICS. Potter, D. E. (Imperial Coll. of Science and Tech., London). pp 79-94 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Fluid problems which occur in the structure of stars, in the solar system, and in laboratory and fusion plasmas are surveyed. These topics are described by the hydrodynamic equations with the inclusion of self-consistent long-range forces: in gravitational hydrodynamics, used to study the evolution, structure and behaviour of stars, the self-consistent gravitational field must be included; in magnetohydrodynamics, the self-consistent electromagnetic fields must be included. Systems of equations for the gravitational and electromagnetic cases are developed, and some simple properties of such equations are analyzed. In particular, the important frequencies associated with the gravitational frequency and with Alfvén waves are stressed. The difference solutions of two particular problems are used to illustrate the general approach. In the gravitational case, a one-dimensional model of stellar pulsation is discussed and an implicit solution to the nonlinear equations described. The approach is also applicable to one-dimensional problems in magnetohydrodynamics. In the electromagnetic case, explicit models for two-dimensional problems are briefly outlined. Such multidimensional problems are of importance in thermonuclear fusion physics, in solar flares, and the magnetosphere. (auth)

13484 PLASMA, GRAVITATIONAL, AND VORTEX SIMULATION. Hockney, R. W. (Univ. of Reading, Eng.). pp 95-107 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Particle models are first compared with fluid MHD models and the time-stepping procedure described. A plasma model is described in detail, and it is shown how this may be re-scaled to become a gravitational or vortex simulation. Examples are given of the use of such models in the study of electron devices, galactic evolution, and fluid flow stability. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

13485 5 GHz OBSERVATIONS OF SMALL-SCALE STRUCTURE IN DR21. Harris, S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 5P-10P(1973).

The H II region DR21 has been observed with the Cambridge 5-km telescope at 5.00 GHz. It is resolved into four compact components of high density and small linear dimensions, surrounded by diffuse envelopes of lower density. The condensations may be at a higher electron temperature than the envelopes. (auth)

13486 INTERPRETATION OF THE REDSHIFT-ANGULAR SIZE DIAGRAM FOR QUASARS. Jackson, J. C. (Royal Greenwich Observatory, Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 11P-13P(1973).

Certain natural assumptions about the evolution of individual quasars allow their redshift–angular size diagram to be interpreted in terms of a quasar population which, with respect to linear dimensions, is not changing with cosmic epoch. (auth)

13487 EVIDENCE FOR LUMINOSITY EVOLUTION OF QUASARS. Zotov, N. V.; Davidson, W. (Otago Univ., Dunedin, N. Z.). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 127-133(1973).

Diagrams are presented showing the systematic increase with z of the optical luminosities of 229 confirmed quasars (QSO and QSS). This does not in itself imply, but is consistent with, the presence of powerful luminosity evolution. Two schemes of pure density evolution of quasars recently advanced by Schmidt (Astrophys. J.; 176: 289(1972)) are examined and their predictions at low flux density compared with comprehensive Parkes data at 1410 MHz and 2700 MHz. The results are in marked disagreement in such a way as to suggest that the postulate of pure density evolution, with neglect of luminosity evolution, is incorrect. (auth)

13488 MODEL FOR X-RAY SOURCES BASED ON MAGNETIC FIELD TWISTING. Bahcall, J. N.; Rosenbluth, M. N.; Kulsrud, R. M. (Inst. for Advanced Study, Princeton, NJ). Nature (London) Phys. Sci.; 243: No. 124, 27-28(14 May 1973).

It is stated that several x-ray sources have been identified with binary stellar systems, and it has generally been assumed that the presence of x rays implies that one of the stars must be a collapsed object (white dwarf, neutron star, or black hole) that accretes matter from the other star, thus producing the x rays. This conclusion is to a large extent based on the absence of any reasonable alternative model for origin of the x rays. Because of the importance of establishing whether binary x-ray sources contain collapsed objects it was felt worthwhile to attempt to construct alternative models and to derive their observational properties. The model proposed is based on magnetic field twisting. It is assumed that the binary system consists of two ordinary but magnetic rotating stars, and that the magnetic flux links the two stars, and that they are not corotating. The linked lines of force will be twisted up, increasing the magnetic energy until instabilities set in and release it in the form of heat that is radiated as x rays. The model predicts large magnetic fields ($\sim 10^4$ gauss) on the surface of at least one star in the binary, and also rotational velocities faster than orbital velocities, that is, lack of corotation. It is related to various theories of solar flares, and does not require that either of the two members of the binary system be collapsed objects. It is aimed at objects, such as Cyg X-1, which exhibit irregular x-ray variations, large luminosities, sometimes ratio emission, and perhaps large masses for the secondary star. (UK)

13489 INTERPRETATION OF THE RADIO EMISSION FROM THE SUPERNOVA REMNANTS CAS A AND 3C 10. Gull, S. F. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 135-142(1973).

The observations of the young supernova remnants Cas A and 3C 10 are interpreted on the basis of a fluid dynamic model of the evolution of young supernova remnants. The shell structure and radio emission are explained in terms of instabilities arising at the boundary between the material ejected by the explosion and the interstellar medium. The model can explain many of the detailed features of the supernovae if the ratios of the mass of interstellar material swept up to that ejected are about 1 for Cas A and about 3 for 3C 10. These ratios lead to estimates for the energies of the original explosions of 5×10^{44} J and 1×10^{45} J, ejected of 2.5 $M_\odot$ and 0.13 $M_\odot$, and external particle densities of 2 to 3 cm^{-3} and 0.18 cm^{-3} for Cas A and 3C 10 respectively. (auth)

13490 RADIO SOURCE SURVEY AT 8000 MHz: THE NUMBER, SPECTRA, AND VARIABILITY OF EXTRAGALACTIC SOURCES. Brandie, G. W. Ann Arbor, MI; Univ. of Michigan (1972). 139p. University Microfilms Order No. 73-11,049.

Thesis (Ph. D.).

An areal survey was conducted at a frequency of 8000 MHz using the University of Michigan 85-foot radio telescope. This survey was undertaken to obtain an unbiased sample of the population of extragalactic sources at 8000 MHz. Fifty-six sources were found by the survey in an area of 0.8 steradian; five of these are newly discovered sources. In terms of the number of beam areas surveyed, this survey, covering an area of about 3.5×10^5 beams, is one of the largest yet conducted. Fourteen of the 56 sources found by the survey were identified as radio galaxies. Twenty-nine were identified as quasi-stellar sources and thirteen, including the five new sources, were unidentified. The spectra of 51 of the sources were studied. Seventeen of the sources had power-law spectra and the other 34 sources all contain at least one compact component showing the effects of synchrotron self-absorption. The differences between the spectra of the radio galaxies and the spectra of the quasi-stellar sources are striking. Repeated observations of 52 of the sources were analyzed for indications of source variability; twenty-one of the sources were found to have varied significantly in flux density at 8000 MHz. An evolutionary sequence of radio sources is discussed in which sources evolve from compact objects observable only at microwave frequencies into extended sources with strong low-frequency emission. An alternative interpretation of the observations is also described. The question of the

relationship between the quasi-stellar sources and the radio galaxies is discussed. (TSS) (Diss. Abstr. Int., B)

13491 LOW ENERGY X-RAY MAP OF PUPPIS A SUPERNOVA REMNANT. Zarnecki, J. C. (University Coll., London); Culhane, J. L.; Fabian, A. C.; Rapley, C. G.; Silk, R.; Parkinson, J. H.; Pounds, K. A. Nature (London) Phys. Sci.; 243: No. 123, 4-5(7 May 1973).

Observations are reported on the low-energy x-ray emissions from the Puppis A supernova remnant using the 0.5 to 1.5 keV detector system of the Mullard Space Science Laboratory grazing incidence telescopes on Copernicus. The whole of the radio remnant was mapped using the 10 arc min. field of view, and some data are also included from the 6 arc min. field of view. The object belongs to a growing list of soft x-ray emitting supernova remnants and is one of the brightest sources of x rays below 2 keV. Its x-ray spectrum is best fitted by a combination of thermal bremsstrahlung and line emission from a plasma at a temperature $\sim 4 \times 10^6$K. The angular size of the x-ray emitting region is less than 0.5 arc deg. The data presented are the first obtained with high spatial resolution in two dimensions. Details are given of the experimental technique and data analysis. It was clear that the bulk of the x-ray emission originates from within the radio shell. The emission was strongly peaked and did not coincide with any of the obvious radio or optical features. If it is assumed that the site of the original Puppis A explosion lies within the present x-ray emitting region present supernova theory can be invoked to explain at least qualitatively the features of the x-ray and radio emission. The existence of a bright compact x-ray emitting region encourages speculation on the possible presence of a compact object. (UK)

13492 X-RAY CLUSTER OF GALAXIES IDENTIFIED IN ERROR BOX 2U2358-29. Thompson, L. A. (Univ. of Arizona, Tucson). Nature (London) Phys. Sci.; 243: No. 123, 5-6(7 May 1973).

The results of a search are reported for rich nearby clusters of galaxies located in those Uhuru error boxes that lie in the declination zone $-27° \geq$ dec. $\geq -45°$. The Uhuru catalogue lists 26 x-ray sources in this range. The error boxes of eight of these sources were searched on the Palomar prints with a low power eyepiece for rich nearby clusters of galaxies, and a cluster of this type was found in the error box of 2U2358-29. Confidence in the identification comes from the coincidence of a radio source with the cluster; the radio source MSH 23-211 falls within the cluster. Two giant SO galaxies, one with an extended asymmetrical halo, dominate the cluster, and the galaxy with the extended halo has an apparent companion. In order to complete the identification of nearby rich x-ray clusters for the entire sky only the region south of dec. $-45°$ remains to be studied. (UK)

13493 PLAZMENNAYA ASTROFIZIKA. (Plasma Astrophysics). Kaplan, S. A.; Tsytovich, V. N. Problemy Teoreticheskoi Astrofiziki. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1972). 440p.

This monograph deals with the subject of plasma turbulence under cosmic conditions. The frequencies and waves of such turbulence, the emission and absorption of waves in plasma, and the excitation and spectra of plasma turbulence are examined. One section is devoted to the sporadic radio emission of the Sun, its ion-sound turbulence, and solar radio flares. The section following considers the plasma astrophysics of galaxies, radiogalaxies, and quasars, including the topics of ultra-relativistic electrons, Compton scattering of electromagnetic and Langmuir waves by relativistic electrons, and a synchrotron interpretation of radio emission of powerful cosmic sources. The last major section summarizes present knowledge concerning pulsar radiation and the turbulence processes in a relativistic plasma. 304 references. (KSW)

13494 IDENTIFICATION OF THE 5C3 RADIO SOURCES. Parkes, A. G.; Penston, M. V. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 117-126(1973).

A set of optical identifications for the radio survey 5C3 are presented. Both photometric and positional criteria are used, the latter utilizing the full authority of the radio positions. Identifications of quasars are complete to U = 19.0 and of galaxies to V $\simeq$ 20. (auth)

13495 SPATIAL DISTRIBUTION AND LUMINOSITY FUNCTION FOR QUASISTELLAR RADIO SOURCES. Arakelyan, M. A. Astrophysics (Engl. Transl.); 6: No. 4, 291-296(1970).

Translated from Astrofizika; 6: No. 4, 531-540(1970).

Expressions for estimating the spatial density of objects of any kind by means of the distances of the nearest ones are obtained using the principle of maximum likelihood. These expressions are used for quasistellar radio sources in the 4C Catalog and the Parkes' survey, assuming that the redshifts are cosmological. The internal consistency of the estimates obtained for the density is considered as an argument in favor of the correctness of the assumption. It is possible to detect a maximum for the optical luminosity function for quasistellar radio sources at $M_V = -23.0$. (auth)

Solar Phenomena

Refer also to abstract 14018.

13496 FINE STRUCTURE IN THE SUNSPOT SPECTRUM, 2 TO 70 YEARS. Currie, R. G. (Magnetic Observatory, Hermanus, Cape Province, S. Afr.). Astrophys. Space Sci.; 20: No. 2, 509-518(Feb 1973).

Application of a new data adaptive approach to power spectrum estimation has yielded evidence for a double solar cycle line in the Zurich sunspot time history. There is significant power from 8 to 15 yr in the spectrum with the primary line at 11.1 yr and three attendant multiplets that may be significant. The first four harmonics of the solar cycle are detected too. Quite marginal evidence for a peak at ~65 yr in the spectrum is presented. These results closely correspond to those recently found in the geomagnetic spectrum. (auth)

13497 MASS AND POSITION LIMITS FOR AN HYPOTHETICAL TENTH PLANET OF THE SOLAR SYSTEM. Rawlins, D.; Hammerton, N. Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 261-270 (1973).

The paper describes an analysis of the residuals of Neptune, conducted in order to delimit the possible range of mass and position for an hypothetical tenth planet of the solar system. Classical perturbation theory was employed, using a least-squares fit to residual normals, the problem being simplified by assuming a circular orbit for any hypothetical body. Results are presented which offer a restricted range of possible values; and their possible significance is discussed. (auth)

13498 CORRELATION BETWEEN 10.7 cm (2800 MHz) SOLAR RADIO EMISSION AND CHROMOSPHERIC FLARES. Maris, G. (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 18: No. 1, 73-77(1973). (In Rumanian).

Correlation coefficients (r) were calculated between 10.7 cm solar radio flux and a daily flare index (flares of importance ≥ 1) for each solar rotation in the 1960–1971 interval. In the 1966–1971 interval these correlation coefficients were recalculated, including the subflares in the daily flare index and they were compared with the coefficients of correlation between 10.7 cm solar radio flux and final values of relative sunspot numbers. Proton flare activity was analyzed for rotations with significant ($r \geq 0.38$) and insignificant ($r < 0.38$) correlation coefficients. This analysis confirmed Croom's conclusion about 10.7 cm (2.8 GHz) solar radio flux and proton flares. (auth)

13499 DETERMINATION OF A PROBABLE INTERVAL FOR THE MEAN TRANSIT TIME FROM THE SUN TO THE EARTH OF THE SOLAR SSC PARTICLES. Nita, I. (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 18: No. 1, 79-84(1973). (In Rumanian).

A probable interval for the mean transit time of the solar SSC particles was obtained by processing the observational data for the 1966–1971 period by correlation methods. All solar flares which preceded a SSC in a 72 hour time interval were considered. This interval was divided in six equal parts. The correlation coefficients between geomagnetic index A_p and flare index X or X_1 were calculated for each interval and indicated a maximum value for the 36 to 48 hour time interval. The 36 to 48 hour interval was divided into four equal parts for which new correlation coefficients were calculated. The results show the 39 to 42 hour interval as the most probable for the transit time from the Sun to the Earth of the solar corpuscular radiation producing SSC, which involves a mean propagation velocity of about 1000 km/s. (auth)

13500 DEPENDENCE OF THE TWO-LEVEL SOURCE FUNCTION ON ITS OWN RADIATION FIELD. Steinitz, R.; Shine, R. A. (Univ. of Colorado, Boulder). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 197-206(1973).

The consequences of the universally made assumption that the stimulated emission profile is identical to the absorption profile are quantitatively investigated for a two-level atom with Doppler redistribution. The nonlinear terms arising in the source function are evaluated iteratively. It is found that the magnitude of the effects is governed by $\zeta = (\exp(h\nu/kT) - 1)^{-1}$ and is probably completely negligible for visible and uv solar lines. For $\zeta = 2$ effects of ~5% are encountered. Larger ζ's lead to numerical instabilities in the method of solution used. (auth)

13501 CAUSE OF THE RESIDUALS IN THE MOTION OF HALLEY'S COMET. Kiang, T. (Dubsink Observatory, Castleknock, Ireland). Mon. Notic. Roy. Astron. Soc.; 162: No. 3, 271-287(1973).

A remarkable periodicity in the residuals in perihelion time of Halley's Comet was recently attributed by Brady (Publ. astr. Soc. Pacific; 84: 314-322(1972)) to the action of a trans-plutonian planet. The main idea of this paper is that, on the contrary, this periodicity can be shown to be an inherent property of the 3-body configuration Sun–Jupiter–Halley. A second-order equation with periodic coefficients is derived, which governs the behavior of any residual in the system. The natural period of this equation, found by Hill's (1886) method of infinite determinant, and verified by numerical integration, turns out to be nearly the same as the observed value of about 600 yr. This idea explains naturally why Brady's synthetic residuals, obtained through the omission of Pluto terms, showed the same period and not the period of Pluto. It is also shown that, (i) the residuals practically vanish when Brady's calculations incorporating his empirical term ϵ_g are used, (ii) the latter term is mathematically equivalent to the outstanding deceleration of Halley's Comet found in a previous paper, and (iii) this deceleration corresponds to a value of $+2.43 \times 10^{-7}$ for Marsden's nongravitational parameter A_2, comparable to the known values for other comets. It is thereby inferred that what actuates the residuals is the same nongravitational force (the jet effect) that has been the subject of much discussion in recent years. In the case of Halley, the nongravitational force appears to have changed little over the last 22 rounds, or 1700 yr. (auth)

13502 TSIKLICHNOST' I PROGNOZY SOLNECHOI AKTIVNOSTI. (Cyclic Recurrence and Forecast of Solar Activity). Vitinskii, Yu. I. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1973). 260p.

This monograph summarizes present information on the recurrence of peaks of solar activity, the 11-year and 22-year cycles, and fluctuations in the sun spot indices. The theory of solar cycles is critically reviewed, and long-term and very-long-term forecasting of total sunspot area is discussed. An appendix gives a 21 page-tabulation of Wolf numbers and other data. 345 references. (KSW)

13503 CAN SOLAR NEUTRINOS HAVE ANOMALOUS GRAVITATIONAL RED-SHIFTS? Tennakone, K. Lett. Nuovo Cim.; 7: No. 9, 358-360(30 Jun 1973).

The argument that the gravitational accelerations of objects made with different materials would differ by an amount larger than the limit set by the Eotvos experiment is used to set an upper limit to the possible anomalous gravitational coupling of neutrinos. It is found that the gravitational force on neutrinos could be enormous compared to the same force on other forms of matter. The existence of such an anomalous gravitational interaction of neutrinos could have tremendous astrophysical and cosmological consequences, the most important of which is that solar neutrinos could be gravitationally red-shifted until they have undetectable energies at the earth. (JFP)

13504 SOLAR RADIATION AND PARTICLE EMISSION. Jensen, E. (Univ. of Oslo). pp 19-43 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

Following a brief general description of the Sun, the structure and properties of the photosphere, the chromosphere, and the corona are described in some detail. The various forms of solar activity, plages, photospheric faculae, quiescent prominences, sunspots, flares, prominences and coronal condensations and their magnetic properties are then discussed. The electromagnetic spectrum in the visual, the uv and x ray, the infrared and the radio regions, and the particle emission from the quiet Sun are dealt with fairly briefly, and finally the emissions from the active Sun are discussed in rather more detail. (NO)

13505 SOLAR WIND. Faelthammar, C. G. (Kungliga Tekniska Hoegskolan, Stockholm). pp 93-102 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

A brief historical and theoretical background of the development of the solar-wind theory is given, followed by a description of the interplanetary plasma. How the solar-wind magnetic field forms an interplanetary magnetic field which guides high-energy charged particles is explained. The interaction between the solar wind and the geomagnetic field, forming the magnetosheath is discussed briefly. (NO)

13506 ENRICHMENT OF SOLAR COSMIC RAYS WITH HEAVY PARTICLES. Konyakhina, S. S.; Kurnosova, L. V.; Logachev, V. I.; Razorenov, L. A.; Fradkin, M. I. Kosm. Issled.; XI: No. 1, 162-163(1973). (In Russian).

The content of nuclei of various elements in solar cosmic rays and in the atmosphere of the Sun was measured relative to oxygen nuclei. From one case to another not only did the intensity and energy spectrum of solar cosmic rays change, but also their nuclear composition. (KSW)

13507 TEST FOR DETECTION OF FINE STRUCTURE OF THE SOLAR WIND. Lotova, N. A.; Chashei, I. V. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 4, 491-501(1973). (In Russian).

The method of search and analysis of fine structure of velocity of interplanetary plasma irregularities is developed. The problem of optimum basis for investigating the fine structure of velocities is considered. (auth)

13508 ACTIVITY OF SOLAR CORONAL CONDENSATIONS DISCUSSED AFTER LONG-ENDURING MICROWAVE EVENTS. Kaufman, P. (Univ. Mackenzie, Sao Paulo, Brazil). Rev. Brasil. Fis.; 1: No. 2, 289-295(Oct 1971).

Long-enduring microwave solar bursts such as gradual rises, falls, rise-and-falls, and absorptions, usually show marked polarization features, as the polarization bursts do. Such effects suggest the consideration of the activity from coronal condensations as a whole rather than isolated burst sources in them. The emission from slowly varying components at microwaves is regulated by collisional and gyro-frequency optical depths in which changes in electron density, temperature, and applied magnetic field morphology can account qualitatively for these microwave events. (auth)

13509 RADIO EMISSIONS FROM SOLAR FLARES. Maxwell, A. (Harvard Coll. Observatory, Cambridge, MA). Sky Telesc.; 46: No. 1, 4-9(Jul 1973).

Some of the recent developments in the study of solar radio emission are summarized. The Culgoora radioheliograph, satellite observations, and pulsations in solar flares are discussed briefly. (WDM)

Galaxies

Refer also to abstracts 13484 and 13492.

13510 NEW OBSERVATIONS OF TWO COMPACT GALAXIES. Penston, M. V.; Penston, M. J. (Hale Observatories, Pasadena, CA). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 109-116(1973).

Very deep integration prints are presented of the compact galaxies BL Lacertae and 3C 390.3. That of BL Lac shows a faint extended object (possibly a galaxy) about 1 arcmin south of BL Lac. The other shows that 3C 390.3 lies in the direction of several galaxies. Scanner observations of 3C 390.3 demonstrate that the light from an annulus centred on the nucleus is probably emitted by stars. Observations of the two other galaxies close to 3C 390.3 show that one is a foreground object, whereas the other has a very similar redshift to that of 3C 390.3 suggesting that any noncosmological component in the redshift of the N-type galaxy is small. (auth)

13511 POLARIZATION OF THE INTERSTELLAR OH-EMISSION. Hall, L. M.; ter Haar, D. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 162: No. 2, 97-108(1973).

Density matrix techniques are used to discuss the behavior of a saturated OH-maser in which only the four lines corresponding to the ground state $^2\pi_{\frac{3}{2}}$, $J = \frac{3}{2}$ quartet are taken into account. The equation of motion for the molecular density matrix is written down and its solution is discussed. It is shown that in a single-line model—which should be applicable to the Class I OH-sources which show strong circularly polarized 1665 MHz emission–saturated maser effects could explain the observed polarization. (auth)

13512 INTERSTELLAR EXTINCTION IN THE SOUTHERN MILKY WAY. Whittet, D. C. B.; Van Breda, I. G.; Nandy, K. (Saint Andrews Univ., Scotland). Nature (London) Phys. Sci.; 243: No. 124, 21-23(14 May 1973).

Interstellar extinction curves have been derived from photoelectric scanner observations of twenty-two reddened early-type stars in a region of the Southern Milky Way, including the galactic center. It has been found that considerable variations exist and that these are not directly related to position in the galactic plane. This indicates that the extinction law for these stars is influenced significantly by the physical conditions prevailing in local dust clouds. (auth)

13513 STRUCTURE OF THE GALAXY. Eggen, O. J.; Freeman, K. C.; Rodgers, A. W. Rep. Progr. Phys.; 36: No. 6, 625-694(1973).

The present knowledge of the stellar content of the Galaxy is summarized and the use of this knowledge in creating a dynamical framework that can be used in an attempt to understand galaxies in general is discussed at some length. The review contains sec-

tions entitled; before 1935, stellar evolution, kinematics, pulsating stars as standard candles, basic stellar dynamics, motions in the Galaxy, the third integral, the collapse of the Galaxy, the galactic disc, the formation and evolution of the Galaxy. (UK)

13514 ORIGIN OF INTERSTELLAR MOLECULES. Shimizu, M. (Univ. of Tokyo). Progr. Theor. Phys. (Kyoto); 49: No. 1, 153-164(Jan 1973).

It is concluded from a thermochemical calculation that the interstellar molecules in the compact H II regions may be formed in places of high temperature and high pressure. A possibility of the locations of molecular formation may be the prestellar atmospheres, but the atmospheres of late type stars are other possible candidates. Detectable interstellar molecules suggested from the above calculation are enumerated. A similarity of the composition of cometary atmosphere to that of the interstellar molecules is pointed out and its implication is briefly discussed. (auth)

13515 INTERRELATION BETWEEN SCULPTOR-TYPE DWARF GALAXIES AND BRIGHT BARRED GALAXIES. Kalloglyan, A. T. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 4, 378-379(1970).

Translated from Astrofizika; 6: No. 4, 683-686(1970).

It is shown that in the Virgo cluster of galaxies the distribution of Sculptor-type dwarfs is more closely connected with the distribution of the barred spirals than with that of the normal spirals. This difference is apparently due to the greater activity of the nuclei of barred galaxies at the early stage. (auth)

13516 DISTRIBUTION OF GALACTIC SHAPES. Fesenko, B. I. (Pskov Pedagogical Inst., USSR). Astrophysics (Engl. Transl.); 6: No. 4, 301-305(1970).

Translated from Astrofizika; 6: No. 4, 549-557(1970).

The distribution of galactic shapes was analyzed with an account of observational selection. The distribution of apparent galactic "sphericities" changes radically when the difference between the absolute magnitudes (of the order of 0.2 to 0.4 m) of a given galaxy in different inclinations with respect to the observer is taken into account. Eliminating galaxies with angular diameters less than 0.5, it is found that among objects with $M < -16m$ ($H = 100$ km/sec·Mpc) the relative number of circular galaxies is $< 5\%$. An equation is derived for the mean intrinsic sphericity $\bar{\xi}$ for the case of small samples. For E galaxies, $\bar{\xi}$ is nearly constant, in the range $-16m > M > -21m$. (auth)

13517 RADIO-LUMINOSITY FUNCTION FOR RADIO GALAXIES. Melik-Alaverdyan, Yu. K. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 4, 297-300(1970).

Translated from Astrofizika; 6: No. 4, 541-548(1970).

The radio-luminosity function for radio galaxies is discussed on the basis of observational data and certain theoretical considerations. It is shown that this function is nonlinear. (auth)

13518 STUDY OF THE VARIABILITY OF THE NUCLEI OF GALAXIES. I. The Optical Variability of 3C 371. Pronik, V. I.; Shcherbakov, A. G. (Crimean Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 6: No. 4, 287-290(1970).

Translated from Astrofizika; 6: No. 4, 525-530(1970).

Observations were obtained for the N galaxy 3C 371 using a two-channel electrophotometer designed for observing diffuse objects and allowing control of the image quality. A 5″ diaphragm was used in a system close to the UBV. The photometer was placed at the Nasmith focus of the 2.6 m reflector of the Crimean Astrophysical Observatory. From May 16 to May 20, 1969, the galaxy increased its brightness by 1.67m, 1.25m, and 0.99m in U, B, and V, respectively. Changes in the spectral indices ($\Delta\alpha_{UB} = -1.91$, $\Delta\alpha_{BV} = -1.04$) led to a flatter spectrum at the moment of maximum brightness. (auth)

Cosmology

13519 COSMOLOGICAL SOLUTION WITH A CONDENSATION. Datta, A. K. (Bangabasi Coll., Calcutta). Indian J. Phys.; 47: No. 2, 120-122(Feb 1973).

An attempt is made, following the lines of McCrea and McVittee (1930-31), to find a solution corresponding to a condensation, represented by a singularity, in a Universe where the energy stress tensor would actually be of the form for a perfect fluid. To facilitate the solution it is assumed that the pressure vanishes and there is only a radial stress due to possible radial motion of matter. (WDM)

13520 COSMOLOGICAL HADRONIC FIREBALL. Sistero, R. F. (Univ. Nacional, Cordoba, Argentina). Astrophys. Space Sci.; 20: No. 1, 19-25(Jan 1973).

Relativistic non-zero pressure cosmology describes a hadronic fireball in the primordial stage of the Universe near the singularity. It is phenomenologically matched to Hagedorn's equation of state based on thermodynamics of strong interactions. (auth)

13521 GRAVITATIONAL INSTABILITY OF REGULAR MODEL UNIVERSES IN A MODIFIED THEORY OF GENERAL RELATIVITY. Nariai, H. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 165-180(Jan 1973).

Any regular model-universe must be nonsingular for an infinitesimal perturbation of the metric, if it exists at all. To examine this problem, the gravitational instability of regular isotropic model-universes in a modified theory of general relativity is investigated, whose gravitational Lagrangian is of the form $L_g = R - (1/\epsilon l^2)(l^2 R)^n$, where l is a characteristic length such that $l \lesssim 10^{7(2n-3n)/(n-1)}$ cm (due to consideration of the solar gravitational field) and n is a numerical constant larger than unity. Dynamical equations for three independent wave modes (i.e., gravitational, rotational, and longitudinal waves) classified by Lifshitz are derived and some characteristic features of these wave modes are touched upon. In particular, the temporal behavior of rotational waves allowable in the regular model-universes found by Breizman et al. ($p = \epsilon/3$) and Gurovich ($p = 0$) in the case $n = 4/3$ is studied in detail. It is shown that their amplitudes become singular at respective characteristic epochs, except in a special model-universe which cannot be applied to the real Universe. Several possibilities to overcome such a difficulty are also discussed. (auth)

13522 ULTRAHIGH ENERGY PHOTONS, ELECTRONS, AND NEUTRINOS, THE MICROWAVE BACKGROUND, AND THE UNIVERSAL COSMIC-RAY HYPOTHESIS. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Space Sci.; 20: No. 1, 47-57(Jan 1973).

The production of ultrahigh energy photons, electrons, and neutrinos as the decay products of pions produced in photomeson interactions between cosmic-ray nucleons and the blackbody microwave background is discussed in terms of the resultant energy spectra of these particles. Simple asymptotic formulas are given for calculating the ultrahigh energy photon spectrum predicted for the universal cosmic-ray hypothesis and the resulting spectra are compared with those obtained previously by numerical means using a different propagation equation for the photons. Approximate analytic solutions for the photon spectra are given in terms of simple power-law energy functions and slowly varying logarithmic functions. These can be used to estimate ultrahigh energy photon fluxes for various astrophysical parameters. The generic relation between the various secondary components is then discussed in terms of their astrophysical implications which are summarized in the conclusion. (auth)

13523 SPATIAL STRUCTURE OF PERTURBATIONS AND ORIGIN OF GALACTIC ROTATION IN FLUCTUATION THEORY. Doroshkevich, A. G. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 6: No. 4, 320-330(1970).

Translated from Astrofizika; 6: No. 4, 581-600(1970).

The statistical properties of density and velocity perturbations were analyzed within the framework of perturbation theory for a homogeneous Friedmann cosmological model. The properties of perturbations near maxima of perturbations in the deformation tensor and density were analyzed. The origin of the angular momentum of galaxies and galactic clusters is discussed. (auth)

13524 FRIEDMANN MODEL UNIVERSES IN A CENTRALLY SYMMETRIC REFERENCE SYSTEM. Stanyukovich, K. P.; Sharshekeev, O. Sh. (Kirghiz State Univ., Frunze, USSR). Astrophysics (Engl. Transl.); 6: No. 4, 313-319(1970).

Translated from Astrofizika; 6: No. 4, 571-580(1970).

Closed, quasi-Euclidean, and open Friedmann model universes were investigated in a central (non-comoving) reference system. In each model two limiting cases are considered, with $p = 0$ and $p = \epsilon/3$. (auth)

13525 CYLINDRICALLY SYMMETRIC NON-UNIFORM UNIVERSE FILLED WITH PERFECT FLUID. Patel, L. K. (Gujarat Univ., Ahmedabad, India). Curr. Sci. (India); 42: No. 13, 457 (5 Jul 1973).

A universe filled with perfect fluid is considered which reduces to a vacuum field described by a metric; $ds^2 = 1/2\sqrt{r}(dt^2 - dr^2) - r(dz^2 + d\phi^2)$ where r, ϕ, and z are cylindrical polar coordinates; when pressure and density become zero. (WDM)

Planetary Phenomena

13526 MAGNETIC FIELD IN THE ENVIRONS OF MARS ACCORDING TO DATA FROM THE MARS-2 AND MARS-3 SATELLITES. Dolginov, Sh. Sh.; Eroshenko, E. G.; Zhuzgov, L. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave

Propagation, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 6, 1296-1299(21 Dec 1972). (In Russian).

Magnetograms taken by Mars-2 and Mars-3 spaceships in 1971-72 provided data on the components of the magnetic field oriented in the direction of the Sun, the universal poles, and certain other coordinates. The aggregate of data on the position of the shock front, "barrier" boundary, topology and magnitude of the field, and the solar-wind intensity may be explained more readily by the concept that the planet Mars possesses an inherent magnetic field with a dipole moment equal to 2.4×10^{22} gauss/cm^3, and an intensity at the magnetic equator of ~60 γ. (KSW)

13527 NATURAL EXOELECTRONIC EMISSION FROM ANORTHOSITE ROCKS BROUGHT BY THE LUNA-20 PROBE. Mints, R. I.; Mil'man, I. I.; Kryuk, V. I.; Tarasov, L. S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 3, 586-588(1973). (In Russian).

The exoelectronic emission of individual feldspar particles of lunar soil retrieved by the Soviet automated space station Luna-20 was studied. The samples were heated to ~500°C in a vacuum at a rate of 0.20° C/sec. The emission curves are discussed in terms of structural defects. (KSW)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

13528 PHYSICS AND CHEMISTRY OF THE IONOSPHERE. Rishbeth, H. (Science Research Council, Slough, Eng.). Contemp. Phys.; 14: No. 3, 229-249(May 1973).

The ionosphere is the part of the upper atmosphere where free electrons exist in sufficient concentrations to affect the propagation of radio waves. This paper introduces the science of the ionosphere and reviews the experimental techniques used in its study. The average behavior of the ionosphere and some of its notable anomalies are described. In the lower part of the ionosphere, between heights of about 60 and 250 km, the distribution of electrons is almost entirely governed by the production and recombination processes. The movement of ionization by winds, electric fields, and diffusion produces some interesting phenomena at heights above 100 km, and mainly governs the electron distribution at heights above 250 km. Finally, ionospheric storms and other problems are touched upon. (auth)

13529 REMARKS CONCERNING THE DIFFUSION OF ION CLOUDS IN THE EARTH'S UPPER ATMOSPHERE. Pickering, W. M. (Univ. of Sheffield, Eng.). Planet. Space Sci.; 21: No. 6, 1073-1075(Jun 1973).

The diffusive motion of initially ellipsoidal plasma irregularities or ion clouds in the Earth's upper atmosphere is studied theoretically using a model similar to that described by Pickering (Planet. Space Sci.; 20: 149 (1972)) for an initially spherical cloud. The work presented here concerns irregularities with major to minor axis ratio between 10:1 and 200:1 at each of the altitudes 97.5 km, 102 km, and 114 km (where the ionization could be produced by meteors) and between approximately 200:1 and 1000:1 for altitudes 210 km and 300 km. In particular the effect of the space-charge electric field on the nature of the diffusion process is discussed. The possible effects of ionospheric electric fields and possible relevance to artificial Ba^+ clouds released in the upper atmosphere are discussed in the second section. (auth)

13530 EVALUATION OF IONOSPHERIC PROBE PERFORMANCE. 2. The Influence of Vehicle Wake Effects On Electron Density and Temperature Measurements. Sturges, D. J. (Univ. of Birmingham, Eng.). Planet. Space Sci.; 21: No. 6, 1049-1071(Jun 1973).

The theoretical performance and accuracy of the Sayers type of r.f. capacitance electron density probe are discussed in some detail, and results from two ionospheric flights of this probe are given. After a brief survey of current satellite wake theories, the broad features of a sounding rocket wake are postulated, and its likely extent calculated by a method applicable to almost any rocket and probe configuration. Both electron density and temperature data are shown to correlate well with the rocket attitude and the postulated wake, confirming the existence of a wake and its importance to probe measurements. Evidence for prolonged outgassing from the rocket motors was also found. (auth)

13531 EVALUATION OF IONOSPHERIC PROBE PERFORMANCE. 1. Evidence of Contamination and Clean-Up of Probe Surfaces. Sturges, D. J. (Univ. of Birmingham, Eng.). Planet. Space Sci.; 21: No. 6, 1029-1047(Jun 1973).

The theoretical performance and accuracy of the Wilson type of electron temperature probe are discussed. Results from two ionospheric flights of this equipment are given, one being the first test of a modified version of the probe allowing detection and measurement of changes in the work functions of the electrodes. The relatively high levels of contamination that were observed were also found to vary markedly during flight, in a manner suggesting that smouldering rocket motors were partly responsible. An unexpected transient behavior of the probe was reproduced in laboratory tests that indicated that ion sheaths were playing an important role. (auth)

13532 DIURNAL, ANNUAL, AND SOLAR CYCLE VARIATIONS OF HYDROXYL AND SODIUM NIGHTGLOW INTENSITIES IN THE EUROPE–AFRICA SECTOR. Wiens, R. H.; Heill, G. (CNRS, Paris). Planet. Space Sci.; 21: No. 6, 1011-1027(Jun 1973).

Average diurnal variation patterns of the nightglow hydroxyl and sodium intensities are studied using data accumulated over several years by filter photometers at stations in the tropics, and north and south temperate latitudes. These average patterns are shown to depend upon season and latitude. They are compared with the frequencies with which various patterns actually occur, and it is shown that with increasing latitude the type of variation seen on a given night becomes less predictable. The sodium emission covaries with the OH diurnally. The annual variations of OH and Na are presented and it is shown that the sodium in the southern hemisphere behaves like the sodium in the northern hemisphere displaced by six months. The annual OH variation does not exhibit this property. The OH intensity follows the solar activity cycle, but the sodium does not. (auth)

13533 ELECTRON DEPLETION IN THE WAKE OF IONOSPHERIC SPACECRAFT. A Comparison Between Results From Langmuir Probes and Antennas. Samir, U.; Weil, H. (Univ. of Michigan, Ann Arbor). Planet. Space Sci.; 21: No. 6, 993-1000 (Jun 1973).

In situ observations of the electron depletion in the wakes of satellites and rockets in the ionosphere using Langmuir-type probes and antennas are analyzed and compared. The quantitative degree of agreement between the results is demonstrated and discussed. One consequence is an improved interpretation of results previously presented for the OGO II wake. (auth)

13534 ENHANCEMENTS OF THE ELECTRON CONCENTRATION IN THE F2-LAYER AT MAGNETIC NOON. Eccles, D. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 35: No. 7, 1309-1315(Jul 1973).

It is shown that maxima which occur in the diurnal variations of f_0F2 at high southern latitudes fall into two categories: 06 UT maxima, which are produced by thermospheric winds, and "secondary ionization maxima", which occur near local magnetic noon. It is suggested that the secondary maxima may be associated with low-energy electron precipitation. Maxima also occur near local magnetic noon in the northern hemisphere in winter; but, because at most of the northern stations local magnetic noon and local noon practically coincide, it is difficult to decide whether these maxima are occurring at local magnetic noon or merely at local midday. (auth)

13535 VLF GONIOMETER OBSERVATIONS AT HALLEY BAY, ANTARCTICA. 1. The Equipment and The Measurement of Signal Bearing. Bullough, K.; Sagredo, J. L. (Univ. of Sheffield, Eng.). Planet. Space Sci.; 21: No. 6, 899-912(Jun 1973).

A transistorized wide-band (0.5 to 11 kHz) vlf goniometer has been developed for the study of whistlers and elf/vlf emissions. It consists of two crossed vertical loops from which a single loop aerial, rotating about a vertical axis at a frequency of 25 sec^{-1}, is synthesized electronically. During periods of high whistler activity, when the same propagation paths may be identified in successive whistler groups, it is possible to determine the bearing of the exit point of such a magnetospheric path with an error, typically, of ±10 to 20°. (auth)

13536 VLF GONIOMETER OBSERVATIONS AT HALLEY BAY, ANTARCTICA. 2. Magnetospheric Structure Deduced From Whistler Observations. Sagredo, J. L.; Bullough, K. (Univ. of Sheffield, Eng.). Planet. Space Sci.; 21: No. 6, 913-926(Jun 1973).

On July 26, 1967, a magnetically quiet day (ΣK_p = 12–) with high whistler activity at Halley Bay, it was found possible, by measurement of whistler noise-frequency and dispersion and the bearings of the whistler exit points, to make a detailed study of the magnetospheric structure associated with the whistler ducts. During the period 0509 to 2305 UT most of the exit points of whistlers inside the plasmasphere were situated along a strip about 100 km wide passing through Halley Bay in an azimuthal direction 30°E of N between 57° and 62° invariant latitude. A mechanism which can give rise to such a well-defined locus which co-rotates with the Earth is not clear. Nevertheless, it does appear that the locus coincides with the contour of solar zenith angle 102° at 1800 UT July 25. This was also the time of occurrence of a sub-storm and it is suggested that the magnetospheric structure was initiated by proton precipitation along the solar zenith angle 102° contour. At midday knee-whistlers observed outside the plasmapause had exit points which were closely aligned along an L-shell at an invariant latitude of 62.5°. They exhibited a marked variation (~3:1) in electron tube content over about 12° of invariant longitude and a drift of about 8 $msec^{-1}$ to lower L-shells. Throughout the period of observation the plasmapause lay about 2° polewards of the mean position found by Carpenter (Radio Sci.; 3: 719-725 (1968)) for moderately disturbed days. (auth)

13537 COSMICAL GEOPHYSICS. Egeland, A.; Holter, O.; Omholt, A. (eds.). Oslo; Universitetsforlaget (1973). 344p.

Separate abstracts were prepared for 15 of the chapters presented. (WDM)

For abstracts of individual chapters see: 13456, 13504, 13505, 13538–13543, and 13552–13557.

13538 COSMICAL GEOPHYSICS; HISTORIC PREAMBLE. Egeland, A. (Norsk Institutt for Kosmisk Fysikk, Oslo); Holter, O.; Omholt, A. pp 11-17 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

A brief description of how the solar wind, in interacting with the geomagnetic field, gives rise to those phenomena which form the scope of cosmical geophysics, is followed by a historical survey of the development of auroral, geomagnetic, and ionospheric physics from 1600 to 1960. (NO)

13539 AURORAL MORPHOLOGY. Omholt, A. (Univ. of Oslo). pp 203-210 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

An introductory description of the auroral display presents the elementary auroral forms and the definition of auroral intensities. The auroral morphology is related to the effect of the Earth as a dipole on the solar wind. The differences between electron and proton aurorae are described. The course of an auroral substorm and auroral variations with solar cycle and seasons are also described. Finally the rapid variations and pulsations occurring during an auroral event are described and discussed. (NO)

13540 PARTICLE PRECIPITATION: SCATTERING AND ABSORPTION. Maehlum, B. N. (Forsvarets Forskningsinstitutt, Kjeller, Norway). pp 211-219 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

Following a general introduction on proton and electron motion, the energy loss and scattering of fast electrons are discussed. The backscattering and absorption of fast electrons by the atmosphere and the effects on the electron scattering and absorption of low-altitude electric fields and geomagnetic field distortions are also treated. The final section deals with the energy loss and penetration depths of proton precipitation. (NO)

13541 PARTICLE PRECIPITATION: IONIZATION AND EXCITATION. Omholt, A. (Univ. of Oslo). pp 221-235 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetforlaget (1973).

Of the energy of the primary particles entering the atmosphere, nearly half is spent in ionizing the atoms and molecules. The ionization process is described. The auroral spectrum and the intensities of the most important lines and bands are then discussed. Excitation by primary particles and secondary electrons, and by other excitation processes are then described. The process of neutralization of protons and reionization is described and hydrogen line data is given. The helium lines are briefly discussed. The height distribution of aurorae and temperatures from auroral spectra are treated in the final sections. (NO)

13542 AURORAL ZONE X-RAYS. Trefall, H. (Univ. of Bergen). pp 237-246 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

The techniques of observing the x rays produced as bremsstrahlung from electron precipitation into the auroral zone are described. The production, propagation, and the energy spectra of these x rays are discussed. Following consideration of the morphology in relation to Akasofu's model of the auroral substorm, the origin of precipitating energetic electrons is discussed. Time variations from very slow pulsations, through irregular and fast pulsations, to microbursts are also discussed and finally the relationships between cosmic noise absorption, auroral-zone x rays, and aurorae are briefly treated. (NO)

13543 WAVES IN PLASMAS. Holter, O.; Kildal, A. (Univ. of Oslo). pp 247-265 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

The basic wave equations are first presented, whereafter the propagation of waves in homogeneous cold plasma is discussed. The connection between the general cold plasma dispersion relation and the Appleton–Hartree formula is established and the whistler mode, ion cyclotron waves, and Alfvén waves are also discussed. The propagation of ion whistlers is used to illustrate the application of cold plasma wave theory in the low-frequency region. Finite temperature effects on the propagation of plasma waves are shown in the case of longitudinal waves. (NO)

13544 REFLECTION COEFFICIENTS OF HYDROMAGNETIC WAVES FROM CONJUGATE IONOSPHERES. Van'yan, L. L.; Kozhevnikov, A. A.; Turbin, Yu. G. Kosm. Issled.; XI: No. 1, 152-154(1973). (In Russian).

The propagation of hydromagnetic waves in the magnetospheric plasma and their interaction with the hydrotropic ionosphere are important in understanding the mechanism of generation of micropulsations. Equations are developed for obtaining the coefficient of reflection for the northern and southern hemispheres. The equations are discussed in relation to the profile of electron concentration and lines of force of the geomagnetic field. (KSW)

13545 INVESTIGATION OF GEOACTIVE CORPUSCLES AND PHOTOELECTRONS WITH THE SATELLITE "KOSMOS-261". Gal'perin, Yu. I.; Vernik, A.; Dymek, M.; Kutiev, I.; Mulyarchik, T. M.; Serafimov, K. B.; Shuiskaya, F. K.; Shulenina, R. V. Kosm. Issled.; XI: No. 1, 101-112(1973). (In Russian).

The energy spectra of ionospheric photoelectrons were determined in the interval 30 to 150 eV by satellite (KOSMOS-348) in the summer of 1970. The averaged spectrum was approximated by two exponents with characteristic energies E_{01} = 10 eV in the energy region 30 to 85 eV and E_{02} = 28 eV in the region 85 to 150 eV. (KSW)

13546 DIRECT MEASUREMENTS OF PLASMA CONVECTION IN THE UPPER ATMOSPHERE. Gal'perin, Yu. I.; Ponomarev, V. N. Kosm. Issled.; XI: No. 1, 88-94(1973). (In Russian).

Measurements of the velocity of convection (ion drift) in a horizontal plane were made from a satellite for the circumpolar and polar upper ionosphere at an altitude of ~ 630 km, on November 4, 1967. A special differential ion counter was oriented relative to the velocity vector of the satellite for proper measurement of the ion current. A component of the electric field along the trajectory of the satellite was found. The convection velocity in the circumpolar sector was $\lesssim$ 1.5 km/sec. with a reversal of sign of drift (direction) at the latitude of the southern polar cap. (KSW)

Effects of Nuclear Detonations

13547 (UCRL-74480) POSSIBLE EFFECT OF NO_x INJECTION IN THE STRATOSPHERE DUE TO PAST ATMOSPHERIC NUCLEAR WEAPONS TESTS. Chang, J. S.; Duewer, W. H. (California Univ., Livermore. Lawrence Livermore Lab.). 2 May 1973. 12p. (CONF-730614-4). Dep. NTIS $3.00.

From conference on environmental impact of aerospace operations in the high atmosphere; Denver, Colorado, USA (11 Jun 1973).

It has been pointed out that the atmospheric nuclear tests in the 1950's and early 1960's injected substantial amounts of NO_x into the stratosphere. Estimates of the net amount of NO_x injection per the possible effects on the O_3 distribution through the NO_x catalytic cycle are made using a time-dependent, parameterized kinetics transport model. By introducing the estimated No_x injection per test chronologically, bounds are obtained for the possible observable perturbations of the O_3 distributions. Comparisons made with existing O_3 measurements may provide a direct test of the validity of the NO_x catalytic cycle in the stratosphere. (auth)

Magnetospheric Phenomena

13548 (LA-UR-73-677) STRIATION OF THE ION CLOUD PRODUCED IN THE OOSIK EXPERIMENT. Bottoms, P. J.; Tierney, M. S. (Los Alamos Scientific Lab., N. Mex.). 2 May 1973. Contract W-7405-eng-36. 13p. (CONF-730442-1). Dep. NTIS $3.00.

Oosik was the name given to a barium release experiment carried out on Mar. 7, 1972, with the intention of tracing an L ~ 6.75 field line from the northern conjugate to the magnetic equator. Several possible mechanisms are examined that could have caused the "striation" of the Oosik fast ion jet. (WDM)

13549 DECAY OF THE MAGNETIC STORM RING CURRENT BY THE CHARGE-EXCHANGE MECHANISM. Proelss, G. W. Planet. Space Sci.; 21: No. 6, 983-992(Jun 1973).

Equatorial charge-exchange lifetimes of ring current protons are recalculated, and the decay of a collection of ring current protons trapped on an L-shell by the charge-exchange mechanism is determined using recent models of the hydrogen geocorona. Observational results pertaining to the decay of ring current energy are briefly discussed, as are a number of competing loss mechanisms. Since charge exchange is a simple physical process which is very efficient in removing ring current energy from L-shells near to the Earth (say, L < 4), it is suggested that it may well be the dominant loss mechanism in this region. (auth)

13550 DIRECTIONAL DIFFUSION COEFFICIENTS OF SOLAR PROTONS INSIDE AND OUTSIDE THE BOW SHOCK. Verzariu, P.; Krimigis, S. M. (Johns Hopkins Univ., Silver Spring, MD). Planet. Space Sci.; 21: No. 6, 971-982(Jun 1973).

The directional diffusion coefficients of low-energy (≥0.3 MeV) solar protons inside and outside the bow shock are examined during the solar flare event of January 24, 1969. The data are derived from simultaneous observations obtained by Explorer 33 inside the magnetosheath and by Explorer 35 in the interplanetary medium. Although the gross properties of the spin-averaged intensities on a diffusion-type plot appear to be the same in both media, the directional intensities show significant variations. It is shown

that directional intensities of low-energy protons can be described reasonably well by anisotropic diffusion with an associated diffusion coefficient. Directional diffusion coefficients are found to differ by a factor as much as three among different directions in space, and from the spin-averaged diffusion coefficient. This suggests that anisotropic diffusion does indeed take place and that so called "isotropic" diffusion coefficients derived in the past from spin-averaged intensities may actually be directional diffusion coefficients in cases where substantial anisotropies (>50%) exist. The typical postulated ratio of field aligned to cross-field diffusion coefficients is $\kappa_\perp/\kappa_\parallel < 0.1$. The present data would indicate a ratio of $\lesssim 0.3$. This value of the anisotropy is to be taken only as an upper limit of the ratio because of the limitations introduced by the wide field of view of the detectors (~90°) and the lack of directional measurements over the entire sphere. Comparison between directional diffusion coefficients in the interplanetary medium and magnetosheath derived from identical directions in space implies changes in the parameters of the interplanetary magnetic field as it interacts with the bow shock. (auth)

13551 INCOHERENT CHERENKOV RADIATION AND ITS AMPLIFICATION VIA THE LANDAU INSTABILITY. Rao, M.; Lalmani, V. V. S.; Tantry, B. A. P. (Banaras Hindu Univ., India). Planet. Space Sci.; 21: No. 6, 1076-1079(Jun 1973).

Quite often the vlf hiss powers recorded by space probes are some orders of magnitude greater than those predicted by the theory of incoherent Cherenkov radiation. It is suggested that the wavegrowth via the Landau instability might satisfactorily account for the disparity between the theory and experiment. (auth)

13552 MAGNETOSPHERE. Block, L. P. (Kungliga Tekniska Hoegskolan, Stockholm). pp 103-119 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

Following a definition of the magnetosphere, its components, such as the magnetotail, neutral sheet, magnetopause etc., are defined and explained. The current systems in the magnetosphere, the open and closed magnetosphere models and convection processes in the outer magnetosphere, are then discussed. The nature of the forbidden region and plasmapause are explained, the ring current and plasma sheet briefly treated, and the tail described. A detailed discussion of the interaction between the ionospheric and magnetospheric plasmas is followed by a section on the laboratory simulation of magnetospheric phenomena. (NO)

13553 MOTION OF CHARGED PARTICLES IN THE MAGNETOSPHERE. Faelthammar, C. G. (Kungliga Tekniska Hoegskolan, Stockholm). pp 121-142 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

The particles are divided into two main groups, those for which the Störmer length is of the order of, or smaller than the linear dimension of the magnetosphere, and those for which it is much larger. Alfvén's perturbation method of computing the drift motion of the particles is then presented in some detail. Following consideration of drift velocity and macroscopic velocity, motion along geomagnetic field lines and transverse drifts in the magnetosphere, the behaviour of low energy (plasma) particles, intermediate (auroral) energy particles, and high-energy (trapped and pseudo-trapped) particles is discussed. A short discussion of the adiabatic invariants, the magnetic moment, the longitudinal invariant and the flux invariant, is given. The magnetic shell parameter is introduced and the basic principles of L-diffusion treated. Finally adiabatic and non-adiabatic acceleration are briefly discussed. (NO)

13554 PARTICLE OBSERVATIONS IN THE MAGNETOSPHERE. Soeraas, F. (Univ. of Bergen). pp 143-160 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

The relationship between motion of the charged particles and their flux and the magnetic control of the particle population by both stable trapping and pseudo-trapping are discussed. The particles in the distant regions of the magnetosphere are treated briefly. Data on the proton and electron populations of the stable trapping region are then presented. In the concluding section the source and loss mechanisms are discussed. (NO)

13555 AURORAL PARTICLES. Hultqvist, B. (Kungliga Vetenskapsakademien, Kiruna, Sweden). pp 161-179 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

A general outline of the distribution and dynamics of auroral particles in the magnetosphere is followed by more detailed treatment of electron precipitation and proton precipitation. The relations between radiation belt particles and auroral particles, the plasma sheet, the ring current and polar cusp are briefly discussed. The dynamics of auroral particle morphology is then treated. The energy spectra of auroral particles and their pitch angle distribution are described and, finally, acceleration and precipitation mechanisms are discussed. (NO)

13556 PERTURBATIONS OF THE GEOMAGNETIC FIELD. Hultqvist, B. (Kungliga Vetenskapsakademien, Kiruna, Sweden). pp 193-201 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

The classical way of organising the data of a magnetic storm is described first, and then the influence of other systems, the solar plasma, the ring current, ionospheric currents, and the magnetic effect of currents in the magnetotail, which have been used in recent years, are treated. Polar magnetic substorms are also discussed in some detail. (NO)

13557 MICROPULSATIONS, WHISTLERS, AND VLF EMISSIONS. Stockflet Joergensen, T. (Danish Meteorological Inst., Copenhagen). pp 301-310 of Cosmical Geophysics. Egeland, A. (ed.). Oslo; Universitetsforlaget (1973).

Micropulsations, whistlers, and vlf emissions are first defined and described and their propagation in the magnetosphere is then discussed. The possible sources of generation of these waves are also discussed. In conclusion the use of such waves in determining the magnetosphere dimensions, plasma density, and electric field is discussed. (NO)

13558 GEOMAGNETIC DISTURBANCE EFFECT ON THE SOLAR DAILY RANGE OF H FIELD. Iyer, K. N. (Physical Research Lab., Ahmedabad, India). Curr. Sci. (India); 42: No. 13, 450-452(5 Jul 1973).

Two extreme definitions of the solar daily range of the geomagnetic H field (i) $\Delta H(R) = H_{max} - H_{min}$ where H_{max} is the instantaneous highest value, and H_{min} the instantaneous lowest value of the H field during the day and (ii) $\Delta H(S) = H_{midday} - H_{night}$ where H_{midday} is the highest mean hourly value between 1100 and 1300 hrs. and H_{night} is the mean hourly value averaged over 0000 to 0300 hrs. and 2100 to 2400 hrs. were compared. The variations of H_{max} and H_{min} with $\Delta H(R)$ and that of H_{midday} and H_{night} with $\Delta H(S)$ were studied for a station under the equatorial electrojet (Trivandrum) and a nonequatorial station (Alibag) during the quiet Sun period 1964-65 for quiet and disturbed days. It was found that while on disturbed days, $\Delta H(R)$ is contributed appreciably by variations in H_{min}, on quiet days the increase of $\Delta H(R)$ is primarily due to increase of H_{max}. The range $\Delta H(S)$ is contributed only by the changes in the daytime value of the field both on quiet as well as on disturbed days. The values of H_{midday} as well as H_{night} seem to be equally depressed on disturbed days, probably due to ring currents established on disturbed days. The range $\Delta H(S)$ as suggested by Chapman and Raja Rao remains unaffected by geomagnetic disturbances. (auth)

13559 DISTRIBUTION OF RADIATION DOSE IN THE RADIATION BELTS OF THE EARTH IN THE YEAR OF MAXIMUM SOLAR ACTIVITY. Savun, O. I.; Senchuro, I. N.; Shavrin, P. I.; Shumshurov, V. I. Kosm. Issled.; XI: No. 1, 119-123(1973). (In Russian).

The distribution of radiation dose in the inner and outer radiation belts behind a shield of ~ 0.7 g/cm^2 using an ionization chamber on the satellite "MOLNIYA-1" is described. The distribution of absorbed dose may be considered typical for geomagnetically quiet periods in the year near the maximum in solar activity (January 1971). The maximum dose-rate level at the center of the inner belt was ~ 520 rad/24 hr behind the shield of 0.7 g/cm^2 with 4π geometry, and ~ 130 rad/24 hr in the outer belt. (KSW)

13560 SECTORIAL STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD AND MAGNETIC EXCITATION IN THE CIRCUMPOLAR REGION. Sumaruk, P. V.; Fel'dshtein, Ya. I. Kosm. Issled.; XI: No. 1, 155-160(1973). (In Russian).

The causes of variations in components of the interplanetary magnetic field (IMF) and Z-components in the circumpolar region are discussed. The IMF possesses an ordered structure in the plane of the ecliptic, the so-called "sectorial" structure, and data taken from the observatories Resolute Bay and Thule on the X, Y, components and the vertical Z-component of the sectorial structure of the IMF are compared. (KSW)

13561 ELECTRON FLUXES WITH ENERGIES GREATER THAN OR EQUAL TO 80 MeV AT THE EQUATOR ACCORDING TO DATA TAKEN FROM THE ARTIFICIAL EARTH SATELLITE "KOSMOS-490". Basilova, R. N.; Grigorov, N. L.; Kalinkin, L. F.; Pugacheva, G. I.; Pryakhin, E. A.; Savenko, I. A. Kosm. Issled.; XI: No. 1, 160-161(1973). (In Russian).

A previous satellite flight had discovered a large electron stream with energies > 10^8 eV. Equipment was accordingly placed aboard the KOSMOS-490 for recording electrons of this

type. The total flux of charged particles recorded at the equator was 2.4×10^{-2} cm^{-2}·sec^{-1}·steradian^{-1}. (KSW)

13562 COLLISIONLESS MODELS OF THE ION EXOSPHERE. Liu, S. C. Pittsburgh; Univ. of Pittsburgh (1972). 115p. University Microfilms Order No. 73-13,239.

Thesis (Ph.D.).

Collisionless models of the ion-exosphere with self consistent electric fields which insure charge neutrality are constructed. The density, temperature, and pitch angle distributions of ions and electrons are calculated for a thermal plasma. In the real magnetosphere the collisionless thermal plasma models may describe the region beyond the plasmapause where field lines are still closed. In the O^+-H^+-e models two sources of electric field parallel to the magnetic field line have been identified. One is charge polarization due to the difference of gravitational forces between ions and electrons. The other is charge polarization due to the difference in diamagnetic forces on ions and electrons. The pitch angle distributions of O^+, H^+ and electrons are found to be different. The energetic plasma in the equatorial region of the L = 5 magnetic field line has also been examined. The electric field set up by the difference in diamagnetic forces of energetic protons and energetic electrons could be an important mechanism for accelerating thermal particles to higher energies. (Diss. Abstr. Int., B)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

13563 (AWRE-O-18/73) INVESTIGATIONS OF VACUUM ARC ION SOURCES. Owen, W. D.; Richardson, M. (Atomic Weapons Research Establishment, Aldermaston (England)). Apr 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25. UK 50 pence.

A theoretical description of the generation and expansion of a vacuum arc cathode plasma was confirmed by experimental measurements indicating that the arc cathode hot spots were a source of high density plasma from which total saturated ion currents in the range of 10 to 20% or the arc current could be extracted for arc currents in the range of 10 to 100 A. The mean expansion velocity and temperature of the plasma measured at a distance of 6 cm from the source were found to be about 1 cm μs^{-1} and 7 eV respectively. Preliminary measurements showed the ionic constituents of the plasma to include singly, doubly, and triply ionized erbium with maximum energies of about 600 eV. (JFP)

Atomic and Molecular Properties

Refer also to abstracts 13167, 13575, 13827, and 14128.

13564 (LBL-1657) EXCITATION ENERGIES IN AN ELECTRICALLY PULSED LIGHT-EMISSION SOURCE APPLIED TO THE SEPARATION OF HIGHER IONIZED ATOMIC STATES: SPECTRA AND ENERGY LEVELS OF SCANDIUM 2^+ AND VANADIUM 4^+. Van Deurzen, C. H. H. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 117p. Dep. NTIS $8.00.

Thesis.

Spectra of vanadium were produced in a vacuum sliding spark and their relative line intensities measured as parameters of the electrical circuit were varied. The relation between the excitation in the source and the electrical circuit parameters may be expressed in terms of the inductance, capacitance, the initial voltage on the capacitor, the two known functions one of which is directly associated with the power delivered to the source during a current pulse and the other with the discharge duration, and two constants which in general depend on the source geometry and the electrode sample material. The circuit parameters were varied to excite and separate spectra of scandium (Sc II and Sc III) by observing total light pulses and spectra of vanadium (V II-V V) by observing both total and time-resolved light pulses. For Sc III, 93 lines are reported in the region 550 Å-9400 Å which give rise to 23 new levels with an accuracy of about 0.03 cm^{-1} and the ionization energy is revised to 199677.37 ± 0.1 cm^{-1}. The results for Sc III have been published in J. Opt. Soc. Am. 63: 158 (1973). For V V, 61 lines in the region 480 Å-8500 Å give rise to 18 new levels and the ionization energy is revised to 526524 ± 5 cm^{-1}. The ionization energies were calculated with a method presented that allows the use of all the known levels in a series simultaneously. Series formulas are presented which are used to predict some of the newly found levels to within 0.25 cm^{-1}. An isoelectronic comparison confirms the inversion of the $3p^64f^2F^0_{5/2,7/2}$ levels in V V as being caused by the interaction of these levels with those of the $^2F^0$ term in the $3p^53d^2$ configuration. (auth)

13565 (LBL-2011) RADIATIVE CORRECTIONS IN HYDROGEN LIKE SYSTEMS. Mohr, P. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). 14 May 1973. Contract W-7405-eng-48. 92p. Dep. NTIS $6.75.

Thesis.

The one-photon self-energy radiative level shift of the $1S_{1/2}$ state of an electron in a Coulomb field is evaluated numerically for values of the nuclear charge Z = 10,20, ...,110. The evaluation is based on the known expressions for the Coulomb radial Green's functions and not on a power series expansion in $Z\alpha$. The errors in the values obtained are estimated to be less than 0.1%. The results are compared with the results of previous calculations. (auth)

13566 THREE-DIMENSIONAL HYDROGEN ATOM AS A RESTRICTED FOUR-DIMENSIONAL HARMONIC OSCILLATOR. Boiteux, M. (Univ., Paris). Physica; 65: No. 2, 381-395 (15 Apr 1973).

It is shown that the study of the quantum hydrogen-atom problem is equivalent to that of a quantum harmonic-oscillator problem in four dimensions, restricted by a superselection rule which results from the invariance of the physical states under the transformations of a one-parametric subgroup of O(4), the kernel of the transformation used. A projected hamiltonian is built up, and a specific perturbational technique is developed. (auth)

13567 FUNDAMENTAL ROTATION-VIBRATION SPECTRUM OF HD. Bejar-Hurtado, J. A. Vancouver, B. C.; Univ. of British Columbia (1972). National Library of Canada, Ottawa.

Thesis (Ph.D.).

Isotopically substituted molecules such as HD, unlike ordinary homonuclear diatomic molecules, possess a small electric dipole moment. This effect is a consequence of asymmetric slippage of the electron cloud with nuclear vibration. The matrix element of the dipole moment for the transition v = 0 to v = 1 in the ground electronic state of HD was experimentally determined by using Fourier transform spectroscopic methods. At pressures below 2 atm the width of the lines due to these transitions was found to be limited by pure Doppler broadening w = 0.026 cm^{-1}, hence no collision narrowing, as occurs in H_2, was observed. From the resolved lines the absolute intensities were obtained and the matrix element computed. The dipole moment $\langle 0/\mu/1\rangle$ for the R-branch was found to increase with J from 4.15×10^{-6} debye, for J = 0, to 8.42×10^{-5} debye for J = 4. Because of the high resolution used, new highly reliable frequencies were obtained. (Diss. Abstr. Int., B)

13568 EFFECT OF VIBRATIONAL MOTION ON THE ELECTRON CHARGE DIFFERENCE DENSITY. Thomas, M. W. (University Coll., Cardiff, Eng.). Chem. Phys. Lett.; 20: No. 3, 303-305(1 Jun 1973).

The effect of the internal vibrational motion on the electron difference density was studied for the hydrogen molecular ion H_2^+. The effect is quite small although there are differences between the static and dynamic densities near the nuclei. (auth)

13569 IMPROVED JAMES FUNCTION FOR THE GROUND STATE OF H_2^+. McEachran, R. P.; Cohen, M. (York Univ., Toronto). Chem. Phys. Lett.; 20: No. 3, 298-302(1 Jun 1973).

The James function for the ground state of H_2^+ was corrected through first order of Rayleigh-Schrödinger perturbation theory. The resulting energies are effectively exact over a range of internuclear separations from 0 to 5 au. (auth)

13570 FLOATING TYPE WAVE FUNCTIONS IN MOLECULAR PSEUDOPOTENTIAL CALCULATIONS. Gaspar, R.; Tamassy-Lentei, I. (Kossuth Lajos Univ., Debrecen, Hungary). Acta Phys. Acad. Sci. Hung.; 33: No. 3-4, 387-398(1973).

Electronic structure, dissociation energy and equilibrium nuclear separation were determined for the molecules CuH, AgH, AuH, ZnH^+, CdH^+, HgH^+, NaH, KH, RbH, CsH, MgH^+, CaH^+, SrH^+, BaH^+ and RaH^+ with the aid of the pseudopotential method. In such XH-type molecules two valence electrons are moving in the field of a proton and a positive ion X^+, the interaction energy of these valence electrons and the positive ion being taken into account by a Hellmann-type pseudopotential. As a first approximation, floating hydrogen-type 1s one-center wave functions are used to describe the closed-shell and open-shell molecular bonding functions. (auth)

13571 OPTIMUM ATOMIC ORBITALS FOR MOLECULAR CALCULATIONS. A Review. Burden, F. R.; Wilson, R. M. (Monash Univ., Clayton, Australia). Advan. Phys.; 21: No. 94, 825-915(Nov 1972).

Over the last fifteen years there has been an immense increase in the variety of functions and methods being used in atomic and molecular quantum mechanics. Their accuracy and ease of use in these systems cover a wide range. The subject is reviewed with the aim of evaluating the suitability of atomic basis sets for calculations on molecular systems. Systems involving the first row atoms and hydrogen are mainly concentrated on. Plausible methods of atomic and molecular nonlinear parameter optimization are considered. Atomic and molecular properties, other than the energy, involving the first row atoms are used as a means of judging the adequacy of each basis set. It will be seen that where suitable adjustment of the atomic orbitals, and hence the basis functions that comprise them, is carried out to allow for the molecular environment that each atom experiences, then the quality of the wave function is enhanced, as indicated by improvement in the molecular properties. Where there have been gaps in the literature, the appropriate properties have been calculated by the authors. (auth)

13572 ADVANCED MOLECULAR QUANTUM MECHANICS. An Introduction to Relativistic Quantum Mechanics and the Quantum Theory of Radiation. Moss, R. E. Studies in Chemical

Physics. New York; John Wiley and Sons, Inc. (1973). 312p. $18.50.

The topics covered are nonrelativistic quantum mechanics, vector and matrix algebra, classical mechanics, special relativity, the interaction of charged particles with electromagnetic fields, classical theory of electromagnetic fields, relativistic wave functions, the Dirac equation, the wave equation for many electrons, the molecular Hamiltonian, the hydrogen atom, quantum field theory, and the interaction of radiation and matter. (JFP)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

13573 LAMB SHIFT IN MUONIC DEUTERIUM. Carboni, G. (CERN, Geneva). Lett. Nuovo Cim.; 7: No. 5, 160-162(2 Jun 1973).

The following contributions to the 2S-2P splitting for μD are calculated: fine and hyperfine structure; muonic Lamb shift, vacuum polarization, nuclear polarization, and nuclear size. (LBS)

13574 SELF-CONSISTENCY OF THE VACUUM POLARIZATION IN MESIC ATOMS. Daniel, H. (Technische Univ., Munich). Lett. Nuovo Cim.; 7: No. 10, 375-376(7 Jul 1973). (In German).

The self-consistency of vacuum polarization in mesic atoms is discussed on the basis of first order terms in the fine structure constant in electron-positron pair production. (LBS)

13575 POSITRON–HELIUM BOUND STATE. Moussa, A. H.; Radi, H. M. A. (Kuwait Univ.). Physics Letters; 43A: No. 6, 517-518(23 Apr 1973).

A variational calculation with a trial wave function including up to 17 parameters was used to investigate the existence of a positron–helium bound state. The resulting binding energy was found to be greater than the helium binding energy, and thus it is believed that the positron does not get bound to a helium atom. The calculations provide also values of ground state helium energy and the corresponding wave functions. (auth)

Collision Phenomena

Refer also to abstract 13572.

13576 (LBL-1900) CORE-LEVEL PHOTOELECTRON SPECTROSCOPY OF SMALL MOLECULES. Davis, D. W. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 94p. Dep. NTIS $6.75.

Thesis.

Relative core-level binding energies and multiplet splittings in binding energies are measured for a number of gases at low pressures and variable temperatures. These measurements are interpreted with CNDO/2 and INDO/2 wave functions. An analysis of the variation in line widths of the measured photoelectron spectra is given. The Auger effect is shown to account for some, but not all of the variation in the line widths. An argument is given for the importance of the Franck-Condon principle in core-level photoionization, particularly in highly fluorinated systems. The Hellman-Feynman theorem is used to derive a quantitative relation between the two most common theoretical interpretations of core-level chemical shifts. The potential-at-a-nucleus approach is used with CNDO/2 wave functions to interpret the measurements made. INDO/2 wave functions are used to interpret the multiplet splittings observed in a number of core-level photoelectron spectra. Koopmans' theorem is shown to be inapplicable to the interpretation of these multiplet splittings. (auth)

13577 (N-73-10685) RELATION BETWEEN MOMENTUM TRANSFER AND CAPTURE AND TOTAL SCATTERING CROSS SECTIONS FOR ION–DIPOLE COLLISIONS. Dugan, J. V. Jr. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1972. 10p. (CONF-721093-1; NASA-TM-X-68151; E-7182). NTIS.

Numerical values of momentum transfer cross sections σ_m for ion–dipole collisions are compared with the corresponding capture cross sections σ_c as a function of ion velocity and rotational temperature. For values of dipole moment μ from 1 to 4 Debyes the σ_m/σ_c ratio is in the range 1.2 to 2.0 (roughly). This is in contrast to the simple relation for Langevin collisions where σ_m/σ_c is equal to or approximately 1.10 independent of polarizability of the target atom. At low temperatures, the momentum transfer cross sections can be as large as 2000 A squared but they are only about 15 to 30 percent of the total scattering cross sections σ_s. (auth)

13578 OPTICAL SPECTRA OF HIGH-PRESSURE HELIUM MIXTURES IRRADIATED BY ALPHA PARTICLES. Thiess, P. E.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 16: 56-57(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

13579 ANOMALOUS LOW-ENERGY Kα LINES IN Al AND Si FROM HIGH-ENERGY OXYGEN BOMBARDMENTS. Richard, P. (Kansas State Univ., Manhattan); Moore, C. F.; Olsen, D. K. Physics Letters; 43A: No. 6, 519-520(23 Apr 1973).

Three prominant peaks are observed in Kα x-ray spectra of both Al and Si at energies below the characteristic K$\alpha_{1,2}$ lines. These emission lines were produced by 30 MeV oxygen bombardment and recorded with a crystal spectrometer. The exact origin of these lines is not understood. (auth)

13580 EXCHANGE SCATTERING IN ELECTRON–ATOM COLLISIONS. Kang, I. J. (Southern Illinois Univ., Edwardsville). New Phys. (S. Korea); 12: No. 4, 204-208(Dec 1972).

The research field of electron–atom collisions is examined for its relative merit among existing sub-fields of physics and for its usefulness in terms of application of its knowledge to other sub-fields. Theoretical formulation of the electron–atom collisions is outlined with its focus on the exchange scattering. Coulomb (distorted) wave approximation, therefrom derived mathematical relations, which exist between the direct and the exchange scattering amplitudes, for both electron impact excitation and ionization processes is further described. Finally, the status of the field is surveyed for various theoretical calculations, and observed results for several processes which are closely related to the exchange scattering. (auth)

13581 ELASTIC SCATTERING OF ELECTRONS BY H_2 IN THE BORN APPROXIMATION. Ford, A. L. (Harvard Coll. Observatory, Cambridge, MA); Browne, J. C. Chem. Phys. Lett.; 20: No. 3, 284-290(1 Jun 1973).

An accurate computation of the differential cross sections for the elastic and vibrational excitation of ground state H_2 by fast electrons is presented. The electronic matrix elements are evaluated at 20 internuclear separations and proper averaging over vibrational wave functions is carried out. The comparison to experiment yields excellent agreement. Different computational procedures appropriate for low and moderate values of momentum transfer are compared. (auth)

13582 EXTRACTION OF INELASTIC SCATTERING INFORMATION FROM APPROXIMATE WAVEFUNCTIONS CONSTRUCTED IN AN L^2 BASIS. Hazi, A. U. (Univ. of California, Los Angeles). Chem. Phys. Lett.; 20: No. 3, 251-256(1 Jun 1973).

It is shown that one can calculate the elements of the reactance matrix from square-integrable approximations to the exact scattering wave functions at energies where no resonances occur. In cases where isolated resonances dominate the scattering, the computational procedure yields the resonance parameters directly. (auth)

13583 POSSIBILITY OF USING THE CAUCHY DISTRIBUTION FOR EXTRACTING THE PARAMETERS OF AUTOIONIZING STATES FROM EXPERIMENTAL DATA. Lipovetsky, S. S.; Senashenko, V. S. (Moscow State Univ.). Phys. Lett.; 44A: No. 3, 225-226(4 Jun 1973).

The possibility of using the Cauchy distribution for extracting the parameters of autoionizing states from experimental data is discussed. Relations for determining the resonance parameters were obtained. (auth)

13584 CONVENIENT EXPRESSION OF THE FLIGHT TIME DISTRIBUTION FOR ELECTRONS IN A SCATTERING MEDIUM IN THE PRESENCE OF AN ELECTRIC FIELD. Bonalum, R. (CISE, Segrate, Italy); Cavalleri, G.; Carotti, A.; Gonzalez-Gascon, F. Lett. Nuovo Cim.; 7: No. 10, 377-382(7 Jul 1973).

An expression is derived for the flight time distribution for electrons influenced by a force field during successive collisions. (LBS)

13585 SPECTROSCOPIC STUDY OF EXCITATION OF AND IONIZATION IN THE COLLISION OF TWO METASTABLE ATOMS. Bochkova, O.; Frish, S.; Tolmachev, Y. (Leningrad State Univ.). Opt. Commun.; 7: No. 4, 423-426(Apr 1973).

Collisions between two excited atoms leading to an increase in the excitation energy of the particles were under investigation. All measurements were made in the afterglow of gas-discharge plasma. The cross sections of the following reactions were determined: $Hg(6^3P_{012}) + Hg(6^3P_{012}) \rightarrow Hg^{**} + Hg(6^1S_0)$, $He_m(2^{1,3}S) + Xe_m(^3P_{0,2}) \rightarrow (Xe^+)^* + He_0 + e$. The cross section of the first reaction for different transitions lies in the region $(2-35) \times 10^{-15}$ cm^2 and the cross section of the second, in $(0.2-2.4) \times 10^{-16}$ cm^2. Pos-

sible systematic errors and the role of cascade transitions are discussed. Cross sections of the Penning reaction $He_m + Xe_0 \rightarrow He_0 + Xe^+ + e$ were also measured. The result is $\sigma(2^3S) = (1.4 \pm 0.2) \times 10^{-15}$ cm^2, $\sigma(2^1S) = (1.2 \pm 0.3) \times 10^{-15}$ cm^2. (auth)

13586 INVERSION PROCEDURE FOR A CERTAIN CLASS OF NONSPHERICALLY SYMMETRIC POTENTIALS. Gerber, R. B. (Weizmann Inst. of Science, Rehovoth, Israel). J. Phys., A (London); 6: No. 6, 770-777(Jun 1973).

An iterative inversion procedure is studied for a particular class of nonspherically symmetric interactions. This class consists of the potentials whose Fourier transform is a product of two factors: a function of the magnitude of the transform-space vector and a function of its direction only. The input data required for the inversion procedure are the amplitude for backward scattering for all the directions of incident momentum (with respect to some specified axis) at a fixed energy, and the value of the spherical average of the interaction, which is assumed to be known. Conditions are established for the convergence of the inversion procedure, and for the existence and uniqueness of a solution of the above-mentioned factorizable form. The results are extended to the much wider class of potentials which can be represented as a sum of N factorizable interaction terms. The inversion method then requires knowledge of the backward scattering amplitude at N different energies. These results have potential applications to the determination of intermolecular forces from scattering data. In this case the spherical average of the potential, knowledge of which is required as input for the above procedure, can itself be determined from scattering data by presently available inversion methods. (auth)

13587 VARIATIONAL CALCULATION OF SCATTERING LENGTH BY THE MODEL HAMILTONIAN. Rabik, L. L. Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 3-5(1973). (In Russian).

Calculations are made of positron-atom scattering length by the model Hamiltonian suggested by Drachman. (auth)

13588 K-SHELL IONIZATION OF BERYLLIUM BY PROTON AND HEAVY IONS. Terasawa, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan); Tamura, T.; Kamada, H. J. Phys. Soc. Jap.; 33: No. 5, 1420-1425(Nov 1972).

Experimental cross sections are presented for the ionization of K-shells of beryllium in collision with heavy ions and proton; C^+, N^+, O^+, Ne^+, and Ar^+ for bombarding energy ranging from 0.3 to 30 keV per amu, while that for protons is 10 to 200 keV per amu. Proton data show good agreement with the prediction for Coulomb excitation of K-shell electrons. The data for heavy ions are several orders of magnitude larger than that for proton. These results are understood in terms of pseudomolecule formation and crossings of molecular orbitals during the collisions. Heavy ion cross sections show the trend to converge to the theoretical Coulomb excitation cross sections in high energies above about 10 keV per amu. (auth)

13589 QUANTUM COMPUTATIONAL PHYSICS OF ATOMS AND MOLECULES. Nesbet, R. K. (IBM Research Lab., San Jose, CA). pp 337-374 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

This paper surveys computational methods currently used in applications of quantum theory to the structure and physical properties of atoms and molecules. Emphasis is placed on applications that require large-scale computation or that involve a major effort of organization or programming. Specific applications and algorithms are discussed for three major computational areas: systems of integro-differential equations, matrix methods, and symmetry algebra. To illustrate the criteria used in development of new methods for large-scale computation, a case study is given of a computer program for electron-atom scattering calculations. (auth)

13590 ACCURATE CALCULATION OF CROSS-SECTIONS FOR NON-REACTIVE MOLECULAR COLLISIONS. Lester, W. A. Jr. (IBM Research Lab., San Jose, CA). pp 375-388 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Computational considerations encountered in the accurate calculation of cross sections for rotational and vibrational excitation of molecules by heavy-particle collision are presented and discussed in the context of the model problem of scattering by a rigid rotator. The nature of the problem is delineated: calculation of the potential-energy hypersurface on which the scattering takes place and the computation of cross-sections using the computed hypersurface. Computational aspects of both parts of the problem are exemplified by recent calculations of a potential-energy surface and rotational energy transfer cross sections for the $Li^+ - H_2$ system. (auth)

Atomic Theory

Refer also to abstract 13643.

13591 NEW RULE FOR X-RAY SPIN DOUBLETS OF MULTIPLY IONIZED ATOMS. Rai, S. (Univ. of Allahabad, India). Nature (London) Phys. Sci.; 243: No. 124, 34-35(14 May 1973).

It is stated that spin doublet formation was observed in x-ray spectra of atoms multiply ionized in their deep layers, but investigation of this is at a very early stage. Regularities and rules of the kind well known for x-ray spin doublets of atoms singly ionised in their inner shells (diagram line spectra) are not yet known for x-ray spin doublets of multiply ionised atoms. The variation of $\Delta\lambda$ with Z is, however, analogous for x-ray spin doublets of singly and multiply ionised atoms. Another important rule well known for x-ray spin doublets of singly ionised atoms is constancy of $\Delta\nu/R$ for constant Z. If such a rule could be found for x-ray spin doublets of multiply ionised atoms the energy difference between those common but unknown x-ray terms that actually take part in the emission of these doublets could be found. Such a rule is here reported for x-ray spin doublets of multiply ionised atoms. A detailed study of the rule and construction of associated energy level diagrams for the x-ray emission lines of multiply ionised atoms is in progress. (UK)

13592 EXTENSION OF THE GEOMETRICAL REPRESENTATION OF THE SCHROEDINGER EQUATION FOR A TWO-STATE SYSTEM TO INCLUDE THE EFFECT OF NONRESONANT LEVELS. Barone, S. R.; Ko, W. C. (Polytechnic Inst. of Brooklyn, Farmingdale, NY). Opt. Commun.; 7: No. 4, 351-356(Apr 1973).

For field intensities which are not too large or rapidly varying, weak excitation of nonresonant levels introduces a time dependent Stark shift of the resonant levels without affecting the total probability of the system being in the resonant levels. Some consequences of this for the theory of ultra-short pulse propagation in a resonant medium are considered. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

13593 (IPPJ-139) NONLINEAR MAGNETOSONIC WAVES PROPAGATING IN A MAGNETIC NEUTRAL SHEET. Sakai, J. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1972. 27p. NTIS (U. S. Sales Only).

Nonlinear magnetosonic waves propagating in a magnetic neutral sheet are investigated within the framework of a fluid model. It is shown that the behavior of the magnetosonic waves are governed by a "modified Burgers equation" with an additional term $c(\eta)\phi$ due to the relevant slowly varying background plasma parameter (density or magnetic field), $[(\partial\phi/\partial\eta) + a(\eta)\phi(\partial\phi/\partial\xi) - b(\eta)(\partial^2\phi/\partial\xi^2) + c(\eta)\phi = 0$, where $\phi(\xi,\eta)$ is the amplitude of the magnetosonic waves, $\xi = \int k_x dx + k_y y - \omega t$, and $\eta = \epsilon x$ is the coordinate stretched by a smallness parameter ϵ. When fast magnetosonic waves propagating toward the neutral region across the magnetic field are considered, they grow and undergo rapid steepening after passing through the neutral region; i.e., shock formation is promoted by the background inhomogeneity. By the numerical computation of the above equation, the time evolution is examined for two initial disturbances, the pulse type (gaussian) and the wave train type (sinusoidal wave). The relevance of the interactions between the magnetosonic shock waves and the neutral sheet plasma to plasma heating and to a triggering mechanism of sympathetic flares is also suggested. (auth)

13594 GEOMETRY OF MAGNETOHYDRODYNAMIC FLOW. Purshotham, G.; Madhusudan, N. (Najasjunasagar Enging Coll., Hyderabad, India). Indian Journal of Science and Industry; 22: No. 2, 131-134(1972).

The geometry of streamline and magnetic lines were considered to study the various kinematic and kinetic properties of magnetohydrodynamic flows. (auth)

13595 RESOLUTION OF CHANDRASEKHAR'S EQUATIONS FOR A MHD TURBULENCE. Codreanu, S. Stud. Univ. Babes-Bolyai, Ser. Phys.; 17: No. 2, 83-86(1972). (In Rumanian).

The possibility is presented of solving the system of Chandrasekhar's equations for a magnetohydrodynamic turbulence, by using the method proposed by Smirnov and Shapiro in the case of ordinary hydrodynamic turbulence. (auth)

13596 HEAT TRANSFER IN MAGNETOHYDRODYNAMIC COUETTE FLOW AS AFFECTED BY WALL ELECTRICAL CONDUCTANCES AND SUCTION. Seshagiri Rao, S. V.; Jain, M. K. Arch. Mech. Stosow.; 21: No. 4, 435-447(1969).

The problem is analyzed for a viscous incompressible electrically conducting fluid transported by two infinite conducting plates moving in opposite directions in a transverse magnetic field with wall suction or injection. Velocity, magnetic field, and temperature profiles were computed along with Nusselt numbers for flow with constant volumetric heat sources and linearly increasing wall temperatures as well as variable heat sources and uniform wall temperatures. The many results are discussed in detail. However, the unusual findings, compared to nonporous walls, are that the solution does not reduce to the zero electric field case for equal wall conductances and the imposed crossflow reduces the effect of the electric and magnetic fields. (Appl. Mech. Rev.)

13597 PARTICULAR CASE OF STABILITY IN AVERAGE OF MAGNETOHYDRODYNAMICS. Nardini, R. Ann. Mat. Pura Appl.; 84: 95-100(1970). (In Italian).

The problem of a particular magnetohydrodynamic phenomenon which generalizes the case of Couette flow for an electrically conducting liquid in the presence of a suitable magnetic field is analyzed. It is demonstrated that every solution of the problem, which has a certain regularity, is stable on the average. (Appl. Mech. Rev.)

13598 HYDROMAGNETIC STABILITY OF PARALLEL FLOW OF AN IDEAL HETEROGENEOUS FLUID. Gedzelman, S. D. (Massachusetts Inst. of Tech., Cambridge). J. Fluid Mech.; 58: No. 4, 777-794(22 May 1973).

The magnetohydrodynamic and Boussinesq approximations are used on a fully ionized ideal fluid with a longitudinal magnetic field. The flow is in a direction normal to the gravity vector and all variations in velocity, density and magnetic field. The stability characteristics, mainly for normal-mode perturbations, are investigated. Two simple problems with discontinuous profiles are solved analytically. For a double shear layer, an appropriate range of magnetic field values destabilizes the flow. A long wave theory is presented and applied to several problems, some of which are destabilized by an appropriate magnetic field. Finally, the solution for continuous profiles is presented and shown to decay algebraically in time for any stable stratification. (auth)

13599 EXISTENCE OF CRITICAL LEVELS, WITH APPLICATIONS TO HYDROMAGNETIC WAVES. McKenzie, J. F. (European Space Research Inst., Frascati, Italy). J. Fluid Mech.; 58: No. 4, 709-726(22 May 1973).

It is proved that a critical level, at which a wave packet is neither reflected nor transmitted, can exist only if the wave normal curve, which is formed by taking the cross section through the wave normal surface in the plane of propagation, possesses an asymptote which is parallel to the direction of variation of the properties of the medium through which the wave packet moves. This condition, when applied to various types of hydromagnetic waves (such as hydromagnetic waves of the inertial or gravity type, or slow magnetoacoustic waves), shows that critical levels for such waves can exist only if the direction of spatial variations of the medium is perpendicular to the ambient magnetic field. Provided that the angle between the gravitational acceleration, or the rotation axis, and the magnetic field is not zero, hydromagnetic critical levels, characteristic of the gravity or inertial type, act like "valves" in the sense that the wave packet can pierce the critical level from one side and is captured from the other side. It is also pointed out that critical-level behavior is to some extent a consequence of the WKBJ approximation since the other limit, namely when the waves feel an almost discontinuous behavior in the properties of the medium, gives markedly different results, particularly in the presence of streaming, which can give rise to the phenomenon of wave amplification. (auth)

13600 FLOW OF AN INCOMPRESSIBLE CONDUCTING LIQUID IN AN ARBITRARY REGION IN THE PRESENCE OF A STRONG MAGNETIC FIELD. Kulikovskii, A. G. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 3, 144-150(1973). (In Russian).

A general expression was obtained which described the flow of a conducting fluid in a random location which was bounded by nonconducting walls. It was assumed that the inertial forces and viscous forces could be neglected in comparison to the magnetic force and the induced magnetic field. (tr-auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 12949.

13601 SEARCH FOR QUARKS. Landsberg, L. G. (Inst. of High Energy Physics, Serpukhov, USSR). Usp. Fiz. Nauk; 109: No. 4, 695-742(Apr 1973). (In Russian).

Following an introductory section on quark models, the symmetry of weak interactions, supermultiplets, and exotic resonances, attention is focussed on the experimental search for quarks with the use of accelerators. Differential cross sections for quark formation and energy dependence, the output of heavy particles, and the search for polyquarks are discussed. The search for quarks in cosmic rays by physicochemical methods, the search for individual particles with a fractional charge, and for quarks in extensive air showers, and the role of quarks in cosmology are reviewed. The statistical theory of quark formation, direct processes of heavy particle formation, and the generation of quarks in electro magnetic processes (''Lepton quarks'') comprise the final section. 97 references. (KSW)

Electromagnetic

13602 (COO-2232-6) SEARCH FOR PHOTOPRODUCTION OF BOSONS BY THE MISSING MASS TECHNIQUE, MEASUREMENT OF THE S AND T DISTRIBUTION OF THE PHOTOPRODUCED HADRONIC CONTINUUM, AND MEASUREMENT OF INCLUSIVE π^+ AND PROTON SPECTRA PRODUCED BY PHOTONS. Gladding, G. E.; Russell, J. J.; Tannenbaum, M. J.; Weiss, J. M.; Thomson, G. B. (Harvard Univ., Cambridge, Mass.). 1972. Contract AT(30-1)-2752. 31p. (CONF-720923-17). Dep. NTIS $3.75.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

The reaction $\gamma + p \rightarrow p + m^0$ was studied with a tagged photon beam of energy range 2.0 to 4.5 GeV. No new resonances were seen in the state m^0 but instead a large nonresonant production was observed. The s and t dependence of this continuum production were measured and found to have interesting properties. In terms of inclusive variables, the photoproduction data strongly resemble hadron initiated reactions. (auth)

13603 (LAL-1266) CONTRIBUTION OF THE PHI MESON TO THE POLARIZATION OF VACUUM BY THE STUDY OF THE REACTION $e^+e^- \rightarrow \mu^+\mu^-$. Fulda, F. (Paris Univ., Orsay (France)). Apr 1973. 195p. (In French). Dep. NTIS (U. S. Sales Only) $11.75.

Thesis.

The study of the $e^+ + e^- \rightarrow \mu^+ + \mu^-$ interaction in colliding beams gave a branching ratio for $\phi^0 \rightarrow l^+ + l^-$ decay of 2.93. This result shows that the effect of vacuum polarization from ϕ^0 on the cross section for the studied reaction with a degree of confidence above 99.3%. This is the first direct experimental evidence of a hadronic contribution to the vacuum polarization. (JFP)

13604 DIRECT PAIR PRODUCTION BY POSITIVE AND NEGATIVE ELECTRONS IN A HYDROGEN BUBBLE CHAMBER. Boehm, J.; Matiova, A.; Trkova, J.; Trka, Z. (Charles Univ., Prague). Nucl. Phys., B; B57: No. 2, 355-366(1973).

The production of electron pairs by negative and positive electrons in the energy region 0.65 to 5.8 GeV was investigated in the DESY 81-cm hydrogen bubble chamber. The effective cross section $\sigma = 0.62 \pm 0.04$ mb averaged over the energy spectrum of incident electrons is found to be in good agreement with the predictions of quantum electrodynamics. The energy distribution of created pairs as well as the dependence of the total cross section on energy are best represented by the expression of Murota, Ueda and Tanaka with the constant $c = 0.66 \pm {}^{0.11}_{0.13}$ and by Bhabha's formula with the constants $c_1 = 1$ and $c_2 = 2.8 \pm {}^{0.5}_{0.7}$. The contribution of the interference term between space-like and time-like Feynman diagrams to the cross section is estimated to be less than about 10% and to fall off with an increase of the incident energy. (auth)

13605 EMPTY TARGET SUBTRACTIONS AND RADIATIVE CORRECTIONS IN ELECTRON SCATTERING EXPERIMENTS. Bodek, A. (Massachusetts Inst. of Tech., Cambridge). Nucl. Instrum. Methods; 109: No. 3, 603-604(1973).

A method of simulating the radiative effects and also considerably reducing the amount of time needed for the measurements of target wall contributions in electron scattering experiments is described. (auth)

13606 MEASUREMENT OF THE ABSOLUTE CROSS SECTION OF THE ELEMENTARY PROCESS OF ELECTRON-ELECTRON BREMSSTRAHLUNG AT 300 keV. Nakel, W.; Pankau, E. (Univ., Tuebingen, Ger.). Phys. Lett.; 44A: No. 1, 65-67(7 May 1973).

The absolute cross section of electron-electron bremsstrahlung which is differential in all the free kinematical variables was measured at 300 keV by using a coincidence technique. A comparison with recent theoretical calculations is given. (auth)

13607 TOTAL HADRONIC PHOTOABSORPTION CROSS SECTIONS ON HYDROGEN AND COMPLEX NUCLEI FROM 4 TO 18 GEV. Caldwell, D. O.; Elings, V. B.; Hesse, W. P.; Morrison, R. J.; Murphy, F. V. (Department of Physics, University of California, Santa Barbara, California 93106); (and others). Phys. Rev. D 7: No. 5, 1362-1383 (1 Mar 1973).

Final total cross sections are given for a counter experiment at SLAC on hadronic photon absorption in hydrogen, deuterium, carbon, copper, and lead at incident energies from 3.7 to 18.3 GeV. Some of the nucleon cross sections have been revised and the C, Cu, and Pb data from 3.7 to 7.4 GeV have not been reported previously. The cross sections for complex nuclei vary approximately as $A^{0.9}$ in our energy range, indicating that the photon interacts, at least partially, as a strongly interacting particle. The energy dependences of the proton and neutron cross sections are also similar to those of hadron-nucleon cross sections and hence may be fitted by a typical Regge parametrization, yielding $\sigma_T(\gamma p) = (98.7 \pm 3.6) + (65.0 \pm 10.1)\ \nu^{-(1/2)}$ μb and $\sigma_T(\gamma n) = (103.4 \pm 6.7) + (33.1 \pm 19.4)\ \nu^{-(1/2)}$ μb, where ν is the photon energy in GeV. These extrapolate to the same value at infinite energy, consistent with Pomeranchukon exchange, and the energy-dependent part yields an isovector-to-isoscalar-exchange ratio of 0.18 ± 0.06. While these observations are qualitatively consistent with vector meson dominance, quantitatively vector dominance fails in relating our results to ρ photoproduction on hydrogen or to experiments determining the ρ-nucleon cross section. Vector dominance cannot be rescued by assuming that the ρ-photon coupling constant depends on the photon mass. Instead, an additional short-range interaction is apparently required, possibly due to a heavy ($\gtrsim 2$ GeV/c^2) vector meson or to a bare-photon interaction. The additional interaction accounts for approximately 20% of the total photoabsorption cross section. (auth)

Weak

Refer also to abstracts 13993 and 14055.

13608 (JINR-P1-7057) IS THE DYNAMICAL INFLUENCE ON THE NEUTRON DECAY POSSIBLE? Glagolev, V. V.; Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 7p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The problem of possible influence on the decay of a free neutron in elastic and inelastic collisions is discussed. Possibility of carrying out the experiments in a hydrogen bubble chamber aimed at search for $n + p \rightarrow 2p + e^- + \bar{\nu}$, $d + p \rightarrow 3p + e^- + \bar{\nu}$; $d + p \rightarrow 3p + n\pi + e^- + \bar{\nu}$, reactions is discussed as well as investigation of the influence of multiple collisions with heavy nuclei at moderation on the neutron decay. (auth)

13609 ANALYSIS OF THE STRUCTURE IN THE $M_{\mu\pi}$ SPECTRA FROM THE K^0_L DECAY. Ramm, C. A. (CERN, Geneva). Nuovo Cim.; 16A: No. 1, 47-60(1 Jul 1973).

The physical structure in the $M_{\mu\pi}$ spectra from the K^0_L, attributed to the existence of neutral heavy leptons, has been analysed in a Dalitz plot of data from a spark chamber experiment which accepts all configurations of the kaon decays. The results are compatible with the existence of a neutral heavy lepton with the previously observed mass: $M^*_{\mu\pi}(429) = (0.429 \pm 0.002)$ GeV. There is also a compatibility between the angular distributions associated with the $M^*_{\mu\pi}$ in these data and those observed in other spark chamber experiments which do not accept all laboratory configurations of the kaon decays. (auth)

Strong (Baryon-induced)

13610 (COO-2232-3) RESULTS ON LARGE TRANSVERSE MOMENTUM PHENOMENA. Buesser, F. W.; Camilleri, L.; Di Lella, L.; Gladding, G.; Placci, A.; Pope, B. G.; Smith, A. M.; Yoh, J. K.; Zavattini, E.; Blumenfeld, B. J.; Lederman, L. M.; Cool, R. L.;,Litt, L.; Segler, S. L. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York; Rockefeller Univ., New York). 1973. 11p. (CONF-730320-2). Dep. NTIS $3.00.

From conference on high energy particle interactions; Nashville, Tennessee, USA (26 Mar 1973).

Preliminary results of an experiment on large transverse momentum phenomena performed at the CERN-ISR at center-of-mass energies of 52.7 and 44.8 GeV are presented. The topics studied were the inclusive reaction $p + p \rightarrow \pi^0 +$ "anything," where the π^0 was emitted around 90° in the center-of-mass system, $(\pi^0\pi^0)$ correlations, and the charged multiplicity associated with large transverse momentum π^0's. In addition, results of a search for electrons and electron pairs are included. (auth)

13611 (JINR-P2-6867, pp 468-503) HADRON ELASTIC SCATTERING AT HIGH ENERGIES. Sviridov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13612 STUDY OF THE REACTION $\bar{p}n \rightarrow N\bar{N}\pi$ FROM 1.0 TO 1.6 GeV/c. Bettini, A. (Univ., Padua); Cresti, M.; Mazzucato, M.; Sartori, S.; Alston-Garnjost, M.; Huesman, R.; Ross, R.; Solmitz, F. T.; Bigi, A.; Carrara, R.; Casali, R.; Lariccia, P.; Pazzi, R.; Borreani, G.; Quassiati, B.; Vigone, M.; Werbrouck, A. Nuovo Cim., A; 15A: No. 4, 563-576(21 Jun 1973).

The reaction $\bar{p}n \rightarrow p\bar{p}\pi^-$ was studied in the c.m. energy interval from 2.08 to 2.29 GeV. The data exclude that the bump observed in the $\bar{N}N$ cross-section for $I = 1$ at a laboratory momentum of 1.32 GeV/c is due to the production of one pion. The cross section for this reaction rises only slowly with energy after the threshold for isobar production is reached. (auth)

13613 INVESTIGATION OF MULTIBARYONIC RESONANCES WITH STRANGENESS EQUAL TO AND DIFFERENT FROM ZERO. Shahbazian, B. A.; Timonina, A. A. (Joint Inst. of Nuclear Research, Dubna, USSR). Nucl. Phys.; B53: No. 1, 19-42(1973).

Results on a search for Λp, ΛΛ, Λpp, K^0p, pp, 3p and 4p resonances are presented. The Λp effective-mass spectrum reveals three significant peaks (more than 4 s.d.) at 2058, 2127 and 2252 MeV. The first two peaks are shown to be due to effects of the negative Λp and Σp scattering lengths respectively, whereas the third peak is interpreted as a Λp resonance of (2251.4 ± 3.9) MeV mass and $\Gamma = (21.1 \pm 5.4)$ MeV full width. The two enhancements observed in the ΛΛ effective-mass spectrum may be due to the effect of the negative ΛΛ scattering length and to a ΛΛ resonance of ~2370 MeV mass. No enhancements in other effective-mass spectra are observed. The results of this work suggest a condition for the possibility of resonance formation depending on the total hypercharge of the system considered. (auth)

13614 REACTION $PN \rightarrow \Delta^{++}(1238)\,\Delta^-(1238)$ AT 5.9 GEV/C. Kirschbaum, A. R.; Colton, E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 5, 1324-1330 (1 Mar 1973).

We present a study of the reaction $pn \rightarrow p\pi^+\pi^-n$. The cross section is found to be 4.75 ± 0.25 mb at 5.9 GeV/c. Decay spherical-harmonic moments are presented for peripheral $|T_z| = \frac{3}{2}$ πN systems as a function of πN-invariant mass. The cross section for the quasi-two-body process $pn\Delta^{++}\Delta^-$ is found to be 1.90 ± 0.14 mb; the differential cross sections and isobar are also studied. The data are not consistent with the predictions of simple one-pion exchange. (auth)

13615 ρ^0-ω INTERFERENCE IN ANTIPROTON ANNIHILATIONS AT 0.65-1.1 GEV/C. Burns, R. R.; Condon, P. E.; Kim, H.; Mandlekern, M. A.; Price, L. R.; (and others) (Department of Physics, University of California, Irvine, California 92664). Phys. Rev. D 7: No. 5, 1310-1314 (1 Mar 1973).

Evidence for ρ^0-ω interference observed in the $\pi^+\pi^-$ mass spectrum from the annihilation $\bar{p}p \rightarrow \pi^+\pi^+\pi^-\pi^-$ at incident momenta between 0.65 and 1.1 GeV/c is presented. The best-fit values for the branching ratio $R(\omega \rightarrow \pi^+\pi^-/\omega \rightarrow \pi^+\pi^-\pi^0)$, phase ϕ, and coherence factor α are 1.3%, 100°, and 0.95. (auth)

Strong (Meson-induced)

Refer also to abstract 12954.

13616 (JINR-P2-6867, pp 389-413) ESSENTIAL SINGULARITY IN THE PROTON MISSING MASS SPECTRA FOR THE REACTION $\pi^- + p \rightarrow p + x^-$ WITH INCIDENT π^- MESON MOMENTA OF 25 AND 40 GeV/c. Poinishvili, V. N. (Inst. of Physics, Tbilisi, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13617 SEARCH FOR I = 2 MULTIPION RESONANCES. Cohen, D.; Ferbel, T.; Slattery, P.; Werner, B. (Univ. of Rochester, NY). Nucl. Phys.; B53: No. 1, 1-8(1973).

A search was made for I = 2 multipion resonances in reactions of the type $\pi^-d \rightarrow pp + x^-$ at an incident π^- momentum of 7 GeV/c. No evidence was found for the existence of resonance-like states in the x^- system, and consequently present upper limits for the production of such resonances in these reactions. (auth)

13618 ELASTIC SCATTERING OF π^-p, K^-p AND $\bar{p}$p AT 25 AND 40 GeV/c. CERN-IHEP, Boson. Nucl. Phys.; B56: No. 2, 333-347(2 Jul 1973).

Elastic diffraction scattering of π^-, K^- and $\bar{p}$ on protons was measured at 25 and 40 GeV/c at the Serpukhov Proton Accelerator. Differential elastic cross sections and diffraction slopes are presented in the momentum-transfer interval $0.07-0.80$ $(GeV/c)^2$ and compared with existing data at lower energies. (auth)

13619 STUDY OF NEUTRAL FINAL STATES IN K-P INTERACTIONS AT CENTER-OF-MASS ENERGIES FROM 1580 TO 1720 MEV. Dombeck, T. (Argonne National Laboratory, Argonne, Illinois 60439); Allison, W. W. M.; Campbell, J.; Cho, Y.; Derrick, M.; (and others). Phys. Rev. D 7: No. 5, 1331-1345 (1 Mar 1973).

The results reported in this paper come from a K-p-formation experiment performed in the Argonne-Michigan 40-in. heavy-liquid bubble chamber. About 500000 pictures were taken in a mixture of 80% propane (C_3H_8) and 20% Freon (CF_3Br) with K^- beam momenta between 730 and 900 MeV/c. Cross sections for the pure isospin states $\Sigma^0\pi^0$, $\Lambda^0\pi^0\pi^0$, and $\Sigma^0\pi^0\pi^0$ in the center-of-mass energy ranging from 1580 to 1720 MeV were measured. Cross-section measurements of the $\Lambda^0\pi^0$, $\Lambda^0\eta^0$, $\Lambda^0\pi^+\pi^-$, and $\Sigma^0\pi^+\pi^-$ final states were compared with previous data obtained using hydrogen bubble chambers to check the validity of our techniques. The cross-section normalization was performed using τ decays to determine the kaon flux. The angular distributions for $\Lambda^0\pi^0$ and $\Sigma^0\pi^0$ are also presented and compared with previous measurements in hydrogen bubble chambers. A check of the technique used previously in hydrogen-bubble-chamber experiments to obtain the $\Sigma^0\pi^0$ angular distributions suggests some contamination in the hydrogen data from the multiple π^0 final states. Our data are consistent with the $\Lambda^0\pi^0\pi^0$ final state being produced almost entirely through Σ (1385) π, and the $\Sigma^0\pi^0\pi^0$ data with almost total Λ (1405) π production. (auth)

13620 ππ PARTIAL-WAVE ANALYSIS FROM REACTIONS $\pi^+P \rightarrow \pi^+\pi^-\Delta^{++}$ AND $\pi^+P \rightarrow K^+K^-\Delta^{++}$ AT 7.1 GEV/C. Protopopescu, S. D.; Alston-Garnjost, M.; Barbaro-Galtieri, A.; Flatté, S. M.; Friedman, J. H.; (and others) (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 5, 1279-1309 (1 Mar 1973).

We present results of an energy-dependent phase shift analysis for ππ energies between 550 and 1150 MeV from reactions $\pi^+p \rightarrow \pi^+\pi^-\Delta^{++}$ and $\pi^+p \rightarrow K^+K^-\Delta^{++}$ at 7.1 GeV/c. The I=0 s wave is parametrized in terms of a 2×2 M matrix coupling ππ and $K\bar{K}$ channels. All the obtained solutions rule out the possibility of a narrow ε resonance in the ρ region and are characterized by a very rapid variation of the I=0 s-wave amplitude near $K\bar{K}$ threshold. We show that this rapid variation can be explained by a pole in the second Riemann sheet close to the $K\bar{K}$ threshold. (auth)

13621 K-D INTERACTIONS AT 5.5 GEV/C: $\Sigma^+\pi^+\pi^-(\pi^0)$, $\Sigma^-K^+K^-$, AND $K^-\pi^-P$ FINAL STATES IN WHICH A HYPERON IS PRODUCED. Kropac, W.; Ammar, R.; Davis, R.; Yarger, H. (University of Kansas, Lawrence, Kansas 66044); Werner, B.; (and others). Phys. Rev. D 7: No. 3, 585-599 (1 Feb 1973).

The results presented in this paper are obtained from an analysis of bubble-chamber pictures of K-d interactions at an incident K^- momentum of 5.5 GeV/c. Generally, the quasi-two-body final states are produced peripherally, with a small backward peak occurring in some of the final states. The final states $\Sigma^-\omega$, $\Sigma^-\rho^0$, and $\Sigma^-\phi$ appear to be produced primarily by vector-meson exchange. In the final state Λ (1520) π^- the decay distributions of the Λ (1520) hyperon are found to be consistent with a vector-exchange production process with M2 coupling at the nucleon vertex. The predictions of the independent-quark model and of other symmetry schemes, namely that the forward cross sections for $\Sigma^-\rho^0$, $\Sigma^-\omega$, $\Sigma^-\phi$ production be in the ratios 1:1:2, are not inconsistent with our experimental values. (auth)

13622 FINAL STATES WITH THREE CHARGED PARTICLES AND A VISIBLE Λ FROM K-D INTERACTIONS AT 4.5 GEV/C. Ammann, A. C.; Carmony, D. D.; Garfinkel, A. F.; Gutay, L. J.; Miller, D. H. (Physics Department, Purdue University, Lafayette, Indiana 47907); (and others). Phys. Rev. D 7: No. 5, 1345-1361 (1 Mar 1973).

This report concerns itself with the study of four- or five-body final states produced by the interaction of 4.48-GeV/c K^- mesons on neutrons. The data result from a 372000-picture exposure in the Argonne National Laboratory 30-in. deuterium-filled bubble chamber. The reactions studied include (1) $K^-n \rightarrow \Lambda\pi^+\pi^-\pi^-$, (2) $K^-n \rightarrow \Sigma^0\pi^+\pi^-\pi^-$, (3) $K^-n \rightarrow \Lambda\pi^+\pi^-\pi^-\pi^0$, (4) $K^-n \rightarrow \Lambda\pi^+\pi^-\pi^-$ MM, (5) $K^-n \rightarrow \Lambda\pi^-K^+K^-$, and (6) $K^-n \rightarrow \Lambda\pi^-K^0_1K^0_2$, where all the Λ particles decayed visibly. Evidence is presented for the existence of the Σ(1640) whose mass and width are 1642 ± 12 MeV/c^2 and 55 ± 24 MeV/c^2, respectively. The branching ratios are found to be consistent with an octet assignment. The A_2 data

are presented and are compatible with $J^{PC}=2^{++}$. In addition, the productions of ρ^0, ω, and ϕ^0 are discussed in conjuction with simultaneous $\Sigma^*(1385)$ production and the results are compared with quark-model predictions. (auth)

13623 $\rho^0\Delta^{++}$ AND $\omega\Delta^{++}$ JOINT DECAY CORRELATIONS AT 3.7 GEV/C. Barnham, K. W. J.; Abrams, G. S.; Butler, W. R. ; Goldhaber, G.; Hall, B. H.; (and others) (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 5, 1384-1394 (1 Mar 1973).

The joint decay density-matrix elements have been measured for the $\rho^0\Delta^{++}$ and $\omega\Delta^{++}$ channels at 3.7 GeV/c. The data are presented as a function of momentum transfer in both the t-channel and s-channel coordinate systems. The presence of correlated decays is illustrated for both reactions by employing selective cuts on the decay angles of one resonance, and displaying the effects on the decay distribution of the opposing resonance. An amplitude analysis is performed with the data 0° production angle, where we obtain a helicity decomposition of the scattering amplitude with no experimental ambiguity. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 14128.

General

13624 (COO-3533-19) LECTURES ON DUAL RESONANCE MODELS. Part Four: Internal Symmetry. Frampton, P. H. (Syracuse Univ., N. Y. Dept. of Physics). Apr 1973. 63p. (SU-4205-19). Dep. NTIS $5.25.

The incorporation of the three internal symmetries relevant to hadron physics, namely, those associated with conservation of isospin, strangeness, and baryon number is considered. (JFP)

13625 (IPPJ-138) NOTE ON THE GAUGE INVARIANCE AND THE CONSERVATION LAWS FOR A CLASS OF NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS. Watanabe, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1972. 19p. NTIS (U. S. Sales Only).

Relations between gauge invariance and the conservation laws are discussed in relevance to Korteweg-deVries' and its relevant equations. The technique employed is conventional in the realm of field theory; the canonical formalism related to the invariant variation problem. The function of constants of motion, when represented in terms of canonical variables is to generate infinitesimal partial gauge transformations of any order, under which the variation problem is invariant. From this point of view, one more example is presented together with the general theory. (auth)

13626 (JINR-P2-6867) SCHOOL OF HIGH-ENERGY PHYSICS FOR YOUNG SCIENTISTS, SUKHUMI, 5-16 OCTOBER 1972. Matveev, V. A. (ed.). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 506p. (In Russian). Dep. NTIS (U. S. Sales Only) $27.50.

There were 16 lectures one of which was abstracted previously in NSA. For an abstract of this paper see abstract number 27: 10672. The remaining 15 lectures are listed separately by title. (JFP)

For titles of individual lectures see: 13611, 13616, 13627, 13628, 13678-13680, 13701, 13725, 13776, 13777, 13819, and 14269-14271.

13627 (JINR-P2-6867, pp 7-55) ANALYTICITY, UNITARITY, AND CONSTRAINTS ON INCLUSIVE CROSS SECTIONS AT HIGH ENERGIES. Logunov, A. A.; Mestvirishvili, M. A. (Inst. of High Energy, Serpukov, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13628 (JINR-P2-6867, pp 56-90) HIGH ENERGY PARTICLE INTERACTION CROSS SECTIONS IMMEDIATELY FOLLOWING THEIR PRODUCTION. Feinberg, E. L. (Lebedev Inst. of Physics, Moscow). 1972. (In Russian).

In school of high-energy physics for young scientists.

13629 DILATATION AND SCALE INVARIANCE OF DUAL AMPLITUDES. Chikashige, Y.; Saito, S. (Tokyo Metropolitan Univ.). Lett. Nuovo Cim.; 7: No. 9, 345-349(30 Jun 1973).

In the dual resonance model the invariance under the conformal transformation is demanded in order to eliminate ghost states. This invariant property is considered as a result of the invariance of the underlying Lagrangian in the string model. A connection between the dilatation transformation and the well known scaling behavior is shown. To illustrate this connection the one-particle distribution function for the inclusive process $a + b \rightarrow c +$ anything (a, b, and c are scalars) is considered. Another illustration is the kind of singularities in the Minkowski space which cause resonances in the dual amplitude. The absorptive part of forward scattering is considered. (JFP)

13630 TACHYONS DO NOT EMIT CHERENKOV RADIATION IN VACUUM. Mignani, R.; Recami, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 7: No. 10, 388-390(7 Jul 1973).

It is emphasized that tachyons are not expected to emit Cherenkov radiation in vacuum. It is pointed out that it is possible to build up a self-consistent classical relativistic theory of tachyons by considering not only particles slower and faster than light but reference frames subluminal and superluminal as well. (LBS)

13631 BOSON REPRESENTATION OF ANGULAR MOMENTUM. I. Mikhailov, V. V. (Physical-Technical Inst., Kazan). Teor. Mat. Fiz.; 15: No. 3, 367-374(Jun 1973). (In Russian).

In analogy with the Schwinger two-boson representation of angular momentum, the representations, including an arbitrary number of boson operators, are developed. The operators, orthonormal bases of eigenstates and coherent states of angular momentum are constructed. Their fundamental properties are investigated, such as completeness, the transformation law under rotations and uncertainty relations, as well as transition to classical limit (for the coherent states). (auth)

13632 CONSEQUENCES OF THE CONVEXITY OF THE LEGENDRE TRANSFORMATIONS (THE GENERALIZED GOLDSTONE THEOREM). Vasil'ev, A. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 15: No. 3, 320-331(Jun 1973). (In Russian).

Various consequences of the convexity of the Legendre transformations proved earlier are analyzed. Different variants of the behavior of the system are considered, in particular, the degeneration and phase transition. The generalization of the Goldstone theorem is proved: in any theory with the continuous symmetry breaking there are zero mass particles. Spontaneous breaking of the continuous symmetry leads automatically to continuous degeneration, which explains the arising of zero mass particles in theories with broken symmetry. (auth)

13633 ENERGY OF A SYSTEM OF MANY BOSONS COUPLED VIA GRAVITATIONAL FORCES. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 15: No. 3, 307-310(Jun 1973). (In Russian).

An expression for the ground-state energy of the system of N bosons interacting by means of gravitational forces is obtained. At $N \rightarrow \infty$ the diagonal part dominates in the operator $\psi(x)$ and determines the leading term in the expansion of E_N for $N \rightarrow \infty$. (auth)

13634 MASS SPECTRUM OF ELEMENTARY PARTICLES. Sinha, K. P.; Sivaram, C. (Indian Inst. of Science, Bangalore). Curr. Sci. (India); 42: No. 13, 445-447(5 Jul 1973).

The physical origin of some of the scaling factors introduced in the mass formula given in a previous paper is explained in terms of interactions involving magnetic charges. The role of gravitation in determining the mass is also clarified in greater detail. (auth)

13635 THEORY OF INTERACTING SPIN-$\frac{3}{2}$ PARTICLE. Fukuyama, T. (Osaka Univ); Yamamoto, K. Progr. Theor. Phys. (Kyoto); 49: No. 1, 304-315(Jan 1973).

A consistent theory of the interacting spin $\frac{3}{2}$ particle is presented. Instead of the constraint conditions, which are the origin of troubles in a theory of interacting higher spin particles, redundant particles are suppressed by making their masses infinite. The theory is general enough to extend to particles with $s > \frac{3}{2}$. (auth)

13636 GENERATING FUNCTIONAL AND SUM RULES FOR CORRELATION FUNCTIONS IN INCLUSIVE REACTIONS. Akiyama, Y. (Tokyo Metropolitan Univ.); Hori, S. Progr. Theor. Phys. (Kyoto); 49: No. 1, 276-281(Jan 1973).

It is shown that constraints on correlation functions in inclusive reactions imposed by the law of energy-momentum conservation can be derived with the aid of the generating functional formalism, without explicit reference to ICSR's. Further it is proved that among the numberless CFSR's thus obtained, only two kinds of CFSR's are mutually independent. (auth)

13637 LINEARIZATION OF THE POMERON EQUATION. Minami, M. (Kyoto Univ.). Lett. Nuovo Cim.; 7: No. 10, 383-387 (7 Jul 1973).

It was previously shown that a wave-mechanical analysis of the one-loop amplitudes in dual-resonance models gives rise to a

functional equation possibly for a pomeron field. It is pointed out that a linearization of the equation is possible. It is suggested that a new kind of dual particle should mathematically exist. (LBS)

13638 EFFECT OF THE FORM FACTOR ON THE NEW PARTICLE'S DECAY. Hayashi, T.; Matsuda, M.; Ogawa, S. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 353-358(Jan 1973).

A study is made of a new particle observed by the Niu group, Prog. Theor. Phys. 46, 1644 (1971). Since the mass of the new particle containing the fourth urbaryon as its constituent seems to be larger by several times than that of the usual hadron, it is examined whether the effect of the form factor might appreciably alter the previous estimation of the decay rate of the new particle. The decay rates of the new particles are recalculated by using a previous form factor, and the results for typical processes are shown. The decay lifetime of $X \rightarrow \Sigma + \pi^0$ is found to be $4.1 \sim 1.7\ (10)^{-12}$ seconds. The new Nagoya model gives $1.9 \sim 0.8\ (10)^{-13}$ seconds. (JFP)

13639 FOUR-DIMENSIONAL INTERPRETATION OF THE INTERNAL SPACE ASSOCIATED WITH THE DUAL-RESONANCE MODELS. Minami, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 594-611(Feb 1973).

An attempt is made to enlarge the internal space in which the dual-resonance models are described: To make closer the analogy with the conventional field theory, the usual planar medium is extended to the one which is realized in the four-dimensional Minkowski space. Furthermore in order to reproduce the usual success in the two-dimensional approximation, the dynamical quantities are assumed to depend on one more external four-vector which plays the role of indicator of several contractions. Discussion is given particularly in favor of the position operators represented in the two- and three-dimensional spaces. (auth)

13640 CAUSALITY AND THE G-FACTOR FOR SPIN-ONE PARTICLE. Prabhakaran, J.; Seetharaman, M. (Univ. of Madras). Lett. Nuovo Cim.; 7: No. 10, 395-397(7 Jul 1973).

The Shay–Good equation (Phys. Rev., 179: 1410 (1969)) is considered for spin-one particles with an anomalous magnetic-dipole interaction term, and it is shown that the causal propagation can be had only if the anomalous moment has a specific nonzero value. It is also shown that when the anomalous moment demanded by causality is included, the g-factor takes the value of unity, contrary to the value of $\frac{1}{2}$ suggested by Shay and Good on the ground of minimal interaction. (LBS)

13641 COMPLETENESS OF THE SOLUTIONS OF A WAVE EQUATION WITH A LINEAR MASS SPECTRUM. Casalbuoni, R. (Istituto Nazionale di Fisica Nucleare, Florence); Longhi, G. Nuovo Cim.; 15A: No. 4, 591-624(21 Jun 1973).

Some of the conditions under which the solutions of an infinite-component wave equation form a complete set are investigated. The investigation is carried out by the resolvent method, and this allows us to find a connection between the NO-GO theorem and the existence or not of the operator exp [πK^3]. As a concrete example the completeness relation is explicitly worked out for the solutions of an equation with a linear mass spectrum; as a consequence of the imposed conditions it is found that the intercept of the trajectory must be $-\frac{1}{2}$. The two Majorana representations are considered, and it is found that completeness holds for the bosonic case only. In this last case it is shown that to the completeness contribute a discrete set of timelike states and a continuum of states with complex energy. (auth)

13642 EFIMOV–FRADKIN FORMALISM FOR NONPOLYNOMIAL INTERACTIONS OF A HARMONIC OSCILLATOR. Houard, J. C.; Teffo, J. L. (College de France, Paris). Nuovo Cim.; 16A: No. 1, 1-36(1 Jul 1973).

The Efimov-Fradkin formalism, devised for nonpolynomial interactions in field theory, is reviewed in the case of zero-dimensional space, that is, when the field variable is replaced by the position co-ordinate of a harmonic oscillator. A rigorous proof of the correctness of that formalism is given in the case where the interaction Hamiltonian is an entire function of the co-ordinate. For rational interactions it is shown that the notion of normal product has to be revised, and a new definition is proposed. In this case the EF expression for the coefficients of the Wick expansion of the amplitudes is divergent and a new expression is derived. (auth)

Electromagnetic

Refer also to abstracts 14000 and 14010.

13643 (CNRS-CPT-72-P-495) GROUP THEORETICAL ANALYSIS OF A NON-RELATIVISTIC PARTICLE IN THE FIELD OF AN ELECTROMAGNETIC WAVE IN THE DIPOLE APPROXIMATION. Kubar-Andre, J. (Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). Dec 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The symmetry properties of a nonrelativistic particle in the field of an electromagnetic wave is considered in the dipole approximation. The space of the states of a spinless Galilean particle in this field is shown to be the space of an irreducible representation of a seven-dimensional subgroup of the Galilei group. (France)

13644 (DESY-73/11) PREDICTIONS OF A QUARK–PARTON MODEL FOR e^+e^- ANNIHILATION INTO HADRONS. Craigie, N. S.; Kraemmer, A. B.; Rothe, K. D. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

A quark-parton model is considered for the e^+e^- annihilation at high energies. The analysis is based on the asymptotic properties of convergent Feynman diagrams. Unlike the uncorrelated jet model of Cabibbo et al., the production of hadrons is supposed to be the result of the final state interaction of a quark-antiquark pair. Despite this interaction, the total cross section still behaves pointlike. Furthermore, the model predicts Bjorken scaling for the inclusive structure functions and a constant mean multiplicity. Also the pion charge distribution is discussed as well as the relative abundance of pions and kaons in the final state. (auth)

13645 (JINR-P2-7117) LIGHT VELOCITY AND DEFINITION OF THE CONCEPTION ABOUT THE LENGTH IN THE GENERAL THEORY OF RELATIVITY. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A possible definition of the conception about the length in the general theory of relativity as an average of distances covered by the light signal in the forward and reverse directions along the given infinitely small scale is discussed. (auth)

13646 RELATIVISTIC OSCILLATION OF CHARGED PARTICLES IN LASER FIELDS AND PAIR PRODUCTION. Hora, H. (Rensselaer Polytechnic Inst. of Connecticut, East Windsor Hill). Nature (London) Phys. Sci.; 243: No. 124, 34(14 May 1973).

It was found that electron-positron pairs may be produced by plasma electrons in extremely high intensity laser fields. At those high intensities the electron follows two given relativistic equations of motion. These equations are effective for electrons from CO_2 laser intensities of 1.2×10^{16} W/cm^2 and for Ne glass lasers of 1.2×10^{18} W/cm^2. The exact solution of these equations for the maximum kinetic energy of the oscillating particles, in excess of the rest energy, is reported, and an exact formula is found for the number of pair productions. (UK)

13647 GENERAL SOLUTION AND INVARIANTS FOR A CLASS OF LAGRANGIAN EQUATIONS GOVERNED BY A VELOCITY-DEPENDENT POTENTIAL ENERGY. Engels, E.; Sarlet, W. (Ghent State Univ.). J. Phys., A (London); 6: No. 6, 818-825(Jun 1973).

It is shown that every generalized force derived from a velocity-dependent potential energy and independent of the acceleration, can be written as an n dimensional 'Lorentz force' with quantities E and B satisfying generalized Maxwell equations. The equations of motion in an n dimensional cartesian space and with $B = B(t)B_0$ are integrated after reduction to canonical form. Expressions for two sets of invariants of the system are constructed and a relation is shown with a class of well known exact and adiabatic invariants for the motion of a time-dependent harmonic oscillator and of a charged particle in a uniform time-dependent magnetic field. (auth)

13648 PROPERTIES OF CHARGED PHOTONS. Bonner, W. B. (Queen Elizabeth Coll., London). Nuovo Cim.; 15A: No. 4, 767-784(21 Jun 1973).

Maxwell's equations admit solutions for charged photons. Some scattering and ionizing properties of these are studied, as well as their motion in electric and magnetic fields. In several respects their behavior is quite different from that of fast-moving charges, and if they exist they should be experimentally detectable. (auth)

13649 COMPTON SCATTERING WITH QUASI-REAL PHOTONS IN ELECTRON–POSITRON STORAGE RINGS. Carimalo, C.; Kessler, P.; Parisi, J. (College de France, Paris). Nucl. Phys., B; B57: No. 2, 582-588(1973).

For electron–positron colliding-beam processes of the type $e^-e^+ \rightarrow e^-e^+$, where one of the $e^\pm$ particles and the photon are detected at large angle, a number of theoretical predictions are

given and compared with some data of a recent experiment performed at Orsay. (auth)

13650 HARD PHOTON CORRECTIONS FOR THE PROCESS $e^+e^- \rightarrow \mu^+\mu^+$. Berends, F. A. (CERN, Geneva); Gaemers, K. J. F.; Gastmans, R. Nucl. Phys., B; N57: No. 2, 381-400 (1973).

The differential cross section for $e^+e^- \rightarrow \mu^+\mu^+$ is calculated to order α^3 for the case of e^+e^- colliding beam experiments in which the charge of the muons is not detected. Special attention is given to hard photon corrections. For a specific experimental set-up, detailed numerical results are presented. It is found that the radiative corrections lie in the range of ±8%, and that approximate calculations cannot be trusted if an accuracy of a few percent is required. (auth)

13651 LOW FREQUENCY PHOTON SCATTERING BY NUCLEI. Eriscon, T. E. O. (CERN, Geneva); Huefner, J. Nucl. Phys., B; B57: No. 2, 604-616(1973).

The low-frequency limit of elastic photon scattering by nuclei of spin zero is studied. The energy independent cross section (Thomson scattering) and the term quadratic in the frequency (Rayleigh scattering) are calculated in two ways: within classical electrodynamics and non-relativistic quantum mechanics. Particular emphasis is put on a correct description of the c.m. motion. The origin of the various retardation and polarizability terms is discussed. They are related to polarizabilities in static external fields. The existence of a dielectric polarizability which is the electric counterpart of diamagnetism is proposed. Orders of magnitudes of the expected effects are given. (auth)

13652 LIGHT CONE AND MASS SHELLS. Jersak, J. (Univ., Bern); Leutwyler, H.; Stern, J. Nucl. Phys.; B57: No. 2, 413-460 (1973).

A hypothesis is proposed which generalizes the notion of duality to off-mass-shell current matrix elements. The hypothesis, referred to as strong light-cone dominance, is formulated in terms of the light-cone sum rules, which reflect causality and the light-cone structure of current commutators: It is postulated that these sum rules are saturated quasilocally by individual resonance peaks, in a similar manner as duality requires resonances to saturate the FESR for the hadronic on-shell amplitudes. This reconstitutes scaling in an average sense in regions where the leading light-cone singularity does not dominate. In coordinate space this hypothesis implies that the leading light-cone singularity regulates (tames) the entire light-cone expansion in a neighborhood of the surface of the light-cone, whose extension is of the order of an inverse mass difference between consecutive resonances. The hypothesis of strong light-cone dominance is investigated in the framework of narrow resonance models for the vertex and it is shown that the leading light-cone singularity indeed normalizes the single particle contributions by means of a relation of the Drell–Yan–West type. A simple Veneziano-like vertex model is exhibited, which is strongly light-cone dominated. Furthermore, it is shown how to exploit the hypothesis in a rather model-independent way. Some applications to the non-forward four-point function are presented and it is shown in particular that strong light-cone dominance requires scaling for exclusive electroproduction processes like $\gamma^* + N \rightarrow \pi + N$. (auth)

13653 ELECTRODYNAMICS WITHOUT ADVANCED FIELDS OR ASYMPTOTIC CONDITIONS. Hogan, P. A. (Dublin Inst. for Advanced Studies). Nuovo Cim.; 15B: No. 2, 136-146(11 Jun 1973).

Recently it has been shown that the Lorentz–Dirac equation of motion for a classical point charge can be derived with the use of retarded potentials only, provided the asymptotic condition of uniform motion in the distant past is imposed. It is demonstrated that this asymptotic condition is unnecessary. (auth)

13654 MODEL FOR THE FORMATION OF A DYON. Kim, Y. (Sogang Univ., Seoul). J. Korean Phys. Soc.; 5: No. 2, 39-42(Sep 1972).

The existence of an effective attractive potential V between an electron and a fixed magnetic monopole, $V = -h^2/2\mu(eg/\hbar c)^2 1/r^2$, where g is the elementary magnetic charge and μ the mass of the electron, was shown. Also the energy spectrum E_p of a dyon atom which is formed by a dyon nucleus and an electron e' bound to it, $-E_p = (ee')^2 2\mu/\hbar^2[2p + 1 + \sqrt{\{(2l+1)^2 - n^2\}}]^{-2}$, where p and n are integers and l the angular momentum was derived. (auth)

13655 SPIN-DEPENDENT FINITE-ENERGY SUM RULES AND LIGHT-CONE COMMUTATORS. Mazzanti, P.; Venturi, G.; Zerbini, S. (Univ., Bologna). Nuovo Cim.; 15A: No. 4, 553-562 (21 Jun 1973).

Spin-dependent finite-energy sum rules are obtained relating the imaginary part of a current proton scattering amplitude to the light-cone commutator of currents. In the derivation of these sum rules the contribution of disconnected states is examined in detail and it is found that it is generally these states that give the dominant contribution on taking the infinite (or quasi-inifinite)-momentum limit for the external states. The consequences of this on the validity of the derivation of the usual sum rules are discussed. (auth)

13656 INELASTIC e–p SCATTERING PROCESS INVOLVING DETECTED FINAL PROTON. Sato, M. (Tokyo Inst. of Tech.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 256-266(Jan 1973).

A phenomenological and simple model based on a statistical assumption is proposed for the semi-inclusive process $e + p \rightarrow e + p + X$ and the inclusive one $e + p \rightarrow e + X$. It is assumed that secondary pions in these processes are emitted with the Maxwell distribution. The gross feature of the electro-production is reproduced by calculating the multiple-particle phase space with the isotropical momentum cut in the c.m. frame of the γ–p system. The parameters in the model are adjustable so as to fit the experimental data. (auth)

13657 GROUP-THEORETICAL ANALYSIS OF A NONRELATIVISTIC PARTICLE IN THE FIELD OF AN ELECTROMAGNETIC WAVE IN THE DIPOLE APPROXIMATION. Kubar-Andre, J. (Centre de Physique Theorique, Marseille). Nuovo Cim.; 15A: No. 4, 577-590(21 Jun 1973).

The symmetry properties of a nonrelativistic particle in the field of an electromagnetic wave are considered in the dipole approximation. It is shown that the space of the states of the Galilean spinless particle in this field is the space of an irreducible representation of a seven-dimensional subgroup of the Galilei group. (auth)

13658 DEEP INELASTIC ELECTRON–DEUTERON SCATTERING AND DEUTERON STRUCTURE FUNCTIONS. Buchl, R. A.; Nigam, B. P. (Arizona State Univ., Tempe). Progr. Theor. Phys. (Kyoto); 49: No. 2, 699-701(Feb 1973).

The cross sections for deep inelastic e + d → e + anything interactions are discussed. It is found that to a good approximation the deuteron structure function is the sum of the proton and neutron structure functions. (JFP)

13659 TOTAL HADRONIC CROSS SECTION AND ABSORPTION OF EXTRAGALACTIC γ-RAYS. Terasaki-Okada, K. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 349-350 (Jan 1973).

The vector-meson dominance and additive quark model are used to evaluate the γ–γ hadronic total cross section. The absorption cross section of 0.3 μb for γ rays of energies above $3(10)^{21}$ eV on the 3° K radiation is obtained. The mean free path for the absorption of γ rays is ½ of the Hubble radius at energies above $3(10)^{21}$ eV. The value of the cross section for $\gamma + \gamma \rightarrow \pi^+ + \pi^-$ interactions is less than 0.0015 μb at energies less than 0.4 GeV. It is concluded that the effect of gamma absorption due to a production of hadrons on the universal radiation may be significant at resonant energies and their vicinity, but it is less important at other energies if the primary gamma rays originate at distances of the order of the Hubble radius. (JFP)

13660 DUALITY CONSTRAINTS ON QUARK PARTON MODEL DESCRIPTION OF DEEP INELASTIC SEMI-INCLUSIVE AND ANNIHILATION PROCESSES. Chaichian, M. (Univ. of Bielefeld, Ger.); Kitakado, S. Lett. Nuovo Cim.; 7: No. 9, 331-336(30 Jun 1973).

Duality is applied to deep inelastic semi-inclusive reactions in the current fragmentation region and to electron–positron annihilation processes in the framework of the quark parton model. Bounds are given for semi-inclusive electroproduction of pions, nucleons, and kaons in the current fragmentation region and on $e^+ + e^-$ annihilation processes. (JFP)

13661 RATIO $\nu W_2^{en}(X)/\nu W_2^{ep}(X)$ AND THE REGGE MODEL. Kim, B. R.; Rodenberg, R. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 7: No. 9, 313-316(30 Jun 1973).

The experimental data for $\nu W_2^{en}(x)/\nu W_2^{ep}(x) > 1 - x$ were represented as an inequality in order to derive an upper bound for the gluon momentum. It was shown that these data are in obvious disagreement with the assumption of a SU(2) symmetric core structure of the nucleon. This inequality contradicts the Regge model for $x \rightarrow 0$. Also these data for $x < 0.2$ seem to fall slightly below the line $1 - x$. It is shown that it is not possible to remove this discrepancy if one assumes the validity of the Regge model for small x and fits the data within this model. (JFP)

13662 LOWER LIMITS FOR THE MASSES OF HYPOTHETICAL CHARGED PARTICLES. Dedenko, L. G. (Moscow Univ.);

Domogatskii, G. V.; Zheleznykh, I. M.; Petrunkin, V. A. Nucl. Phys., B; B57: No. 1, 263-268(1973).

Lower bounds on the masses of hypothetical charged particles with spin S(0, ½ and 1) are obtained from the present data on the muon anomalous magnetic moment: $m_0 \geq 2.5$ MeV, $m_{½} \geq 24$ MeV, $m_1 \geq 100$ MeV (84% confidence level). An expected improvement in the experimental error in $((g-2)/2)^{EXP}$ to the order of $\pm 2 \times 10^{-8}$ might result in the increase of the lower bounds on these masses to $m_0 \geq 50$ MeV, $m_{½} \geq 170$ MeV, and $m_1 \geq 430$ MeV (84% confidence level). (auth)

13663 HIGH ENERGY PHOTO-REACTIONS AND GENERALIZED VECTOR MESON DOMINANCE MODEL IN THE RELATIVISTICALLY EXTENDED QUARK MODEL. Kobayashi, T. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 49: No. 1, 282-292(Jan 1973).

A generalized vector meson dominance model which is derived from the quark model with the relativistically extended internal structure is applied to high energy photo-reactions, i.e., $e^+e^- \rightarrow$ vector meson (V_λ^0), Compton scattering and photoproductions of vector mesons. In this model it is predicted that infinite numbers of vector mesons must be introduced to describe the currents of hadrons. It is shown that the discrepancy among photo-vector meson transition couplings derived from the reactions $e^+e^- \rightarrow V_\lambda^0$, $\gamma p \rightarrow \gamma p$, $\gamma d \rightarrow \gamma d$, and $\gamma p \rightarrow V_\lambda^0 p$ with the aid of the usual vector meson dominance model in which only ρ-, ω-, and ϕ-mesons are adopted is corrected and the couplings of all reactions can consistently be reproduced by introducing the infinite numbers of vector mesons predicted by the model. It is also shown that the contributions of mesons other than ρ, ω, and ϕ are expected to become remarkable at large momentum transfers. Predictions of $\Gamma(V_\lambda^0 \rightarrow e^+e^-)$ and $d\sigma/dt(\gamma p \rightarrow V_\lambda^0 p)|_{t=0}$ are presented. Comparison of the results with some experiments on the first-excited vector meson is also carried out. (auth)

13664 CALCULATION OF ELECTRON–ELECTRON BREMSSTRAHLUNG CROSS SECTIONS. Mack D.; Mitter, H. (Univ., Tuebingen, Ger.). Phys. Lett.; 44A: No. 1, 71-72(7 May 1973).

The differential cross section for bremsstrahlung emission in electron–electron-collisions was calculated using computer programs for formula manipulations. Results are reported for the arrangement used in recent experimental investigations. (auth)

13665 π^0 PHOTOPRODUCTION IN A WEAK-REGGE-CUT MODEL. Goldstein, Gary R.; Owens III, Joseph F. (Department of Physics, Tufts University, Medford, Massachusetts 02155). Phys. Rev. D 7: No. 3, 865-879 (1 Feb 1973).

A weak-Regge-absorption model using ω, ρ, B, and H exchanges is applied to neutral pseudoscalar meson photoproduction and related reactions. The theoretical constraints of duality, SU(3), and vector dominance are imposed in order to simplify the model as much as possible. Satisfactory agreement is found, with a small set of free parameters, for all of the reactions considered. (auth)

13666 ELECTROMAGNETIC PARITY VIOLATION FOR HADRONS. Henley, E. M. (Department of Physics, University of Washington, Seattle, Washington 98195); Huffman, A. H.; Yu, D. U. L. Phys. Rev. D 7: No. 3, 943-946 (1 Feb 1973).

It is argued that a first-order weak direct parity-violating electromagnetic interaction should exist for hadrons. The interaction vanishes for real photons if the initial and final hadrons are identical and if off-mass-shell effects are neglected; the interaction contributes to reactions where this is not the case or for virtual photons. Estimates of the magnitude of parity-violating effects are made for nuclear electromagnetic transitions and for electron-proton elastic scattering. It is shown that asymmetries $\simeq 10^{-6}$–10^{-5} can be expected in 20-GeV elastic electron scattering from polarized protons. (auth)

13667 TWO-PION INTERMEDIATE STATES IN THE DECAY $K_s^0 \rightarrow 2\gamma$. Goble, Robert L. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. D 7: No. 3, 931-933 (1 Feb 1973).

The unitarity relations for the two-pion intermediate state in the decay $K_s^0 \rightarrow 2\gamma$ are solved using a recently derived form for the amplitude for the process $2\gamma \rightarrow 2\pi$, which keeps the exact one-pion-exchange contribution, but neglects the left-hand cut and inelastic cuts in the π–π scattering amplitude. The resulting amplitude shows no direct enhancement of the decay rate from strong interactions, and the rate could be zero if the cross section for $2\gamma \rightarrow 2\pi$ were zero at the K mass. A plausible choice of the amplitude for $2\gamma \rightarrow 2\pi$ gives a contribution which has exactly the magnitude that would be calculated using perturbation theory for pointlike pions with no strong interactions, but is shifted by the π–π scattering phase leading to a unitarity lower bound that is smaller by about a factor of two. (auth)

13668 THEORY OF PHOTOPRODUCTION IN THE REGION OF THE SECOND RESONANCE. Aaron, R. (Department of Physics, Northeastern University, Boston, Massachusetts 02115); Amado, R. D. Phys. Rev. D 7: No. 5, 1544-1548 (1 Mar 1973).

Exploiting the virtual effects of ρ production in the πN D_{13} and D_{33} waves, and using vector dominance, we study single-pion photoproduction. We show that dominant features of photoproduction in the second-resonance region can be explained by these mechanisms. (auth)

13669 PHOTON–NEUTRINO–ANTINEUTRINO COUPLING IN $\rho^0 \rightarrow \nu\bar{\nu}$ DECAY. Buchl, R. A.; Nigam, B. P. (Department of Physics, Arizona State University, Tempe, Arizona 85281). Phys. Rev. D 7: No. 5, 1554-1556 (1 Mar 1973).

The decay $\rho^0 \rightarrow \nu\bar{\nu}$ is postulated. The decay width is calculated by two different methods. One method involves the neutrino electromagnetic form factor and the other involves a direct $\gamma\nu\bar{\nu}$ vertex since it has been proposed that photons can interact weakly with neutrino–antineutrino pairs with coupling strength g. For the case of muon neutrinos after setting the cutoff Λ equal to various values of the spin-one boson mass M_W, we estimate $g^2{}_\mu \simeq 10^{-15}$. (auth)

13670 COMMENT ON "ARE THERE FIXED SINGULARITIES IN T_1?". Creutz, Michael (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 7: No. 5, 1539-1540 (1 Mar 1973).

We show that the conclusion of Zee on the presence of fixed J=0 singularities in virtual Compton scattering is unfounded. Thus, there is no model-independent argument for such a behavior. (auth)

13671 METHOD FOR CALCULATING ELECTROMAGNETIC MASS DIFFERENCES OF HADRONS: APPLICATION TO THE PION AND KAON. Wilcox, Thomas J.; Norton, Richard E. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 7: No. 3, 879-887 (1 Feb 1973).

A method is presented for the calculation of hadronic electromagnetic mass differences and is applied to the calculation of $m_{\pi^\pm} - m_{\pi^0}$ and $m_{K^\pm} - m_{K^0}$. Our results, although far from conclusive, include an explanation of the observed sign and general magnitude of $m_{K^\pm} - m_{K^0}$. In contrast with the familiar Cottingham approach the method apparently fails for $m_{\pi^\pm} - m_{\pi^0}$. (auth)

13672 GAUGE INVARIANCE, CHIRAL SYMMETRY, AND THE DECAY $\eta \rightarrow \pi^0\gamma\gamma$. Dass, N. D. Hari (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 7: No. 5, 1458-1462 (1 Mar 1973).

We consider a closed-fermion-loop model for the decay $\eta \rightarrow \pi^0\gamma\gamma$. We incorporate chiral symmetry and gauge invariance and derive an effective Lagrangian for the above decay using a method first introduced by Schwinger. The effective Lagrangian is derived by treating the mesons as soft. The effect of symmetry breaking is also considered. We come to the surprising conclusion that in the limit of exact $SU_2 \times SU_2$ or $SU_3 \times SU_3$ the decay is strictly forbidden. The symmetry-breaking limit gives an extremely suppressed width for the decay $\eta \rightarrow \pi^0\gamma\gamma$. (auth)

13673 LOW-ENERGY LIMIT IN HARD-PION AMPLITUDES AND MAGNETIC MOMENT OF CHARGED ρ MESONS. Shtokhamer, R.; Singer, P. (Department of Physics, Technion–Israel Institute of Technology, Haifa, Israel). Phys. Rev. D 7: No. 3, 790-794 (1 Feb 1973).

A method previously used for deriving Kawarabayashi–Suzuki–Riazuddin–Fayyazuddin (KSRF) –type relations is applied here to the radiative decay $\rho^+ \rightarrow \pi^+\pi^0\gamma$. Comparing the amplitude calculated with the hard-pion technique to its exactly calculable (photon) low-energy limit, one obtains as consistency conditions the first Weinberg sum rule, the modified KSRF relation, and the magnetic moments of A_1 and ρ^+. The value for the last one is further investigated in a model devoid of the single-particle approximation, the result consisting of upper and lower bounds for it, namely, $16\pi^2\alpha^2 g_\rho{}^2/(m_\rho{}^4 I\sigma, +_\infty - _{s_0} ds) < \mu_\rho < 2$. (auth)

13674 DRELL-YAN SCALING IN SEMI-INCLUSIVE ELECTROPRODUCTION. Colglazier, E. W. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Ravndal, F. Phys. Rev. D 7: No. 5, 1537-1539 (1 Mar 1973).

The scaling behavior of deep-inelastic single-particle electroproduction (or neutrino production) expected from the parton model has been given by Drell and Yan as $\nu^1 W_2$ when the observed hadron has a finite fraction of the virtual photon's laboratory momentum. Although Drell and Yan give the correct scaling behavior with their choice of variables, we show that with variables more appropriate experimentally, the proper scaling is $\nu^2 W_2$. Recent data previously thought inconsistent with the parton model are now found to be in agreement, which is especially important since scaling in this kinematic region cannot be predicted from a light-cone analysis. (auth)

13675 RESONANCE FORM FACTORS, SCALING, AND REGGE BEHAVIOR IN INELASTIC ELECTRON–NEUTRON

SCATTERING. Avni, Y.; Milgrom, M. (Department of Physics, The Weizmann Institute of Science, Rehovot, Israel). Phys. Rev. D 7: No. 5, 1463-1468 (1 Mar 1973).

Interrelations between the behavior of inelastic electron–nucleon scattering structure functions in the scaling limit and in the Regge limit, and the Q^2 dependence of form factors, are discussed. The case of a uniform scaling limit is studied. As an application, we explain why some existing resonance models with a universal (or effective) form factor cannot have Regge asymptotics. (auth)

13676 FINITE P–N MASS DIFFERENCE IN THE COTTINGHAM FORMULA. Yabuki, H. (Kyoto Univ.). Lett. Nuovo Cim.; 7: No. 8, 300-304(23 Jun 1973).

The condition for the convergence of the deep inelastic contribution to the Cottingham formula is examined in detail, and an estimate is made of the magnitude of the inelastic (deep inelastic and Regge) contributions to the p-n mass difference. (LBS)

Weak

13677 (BNL-17866) POSSIBLE EFFECTS OF WEAKLY COUPLED NEUTRAL CURRENTS IN $pp \rightarrow l^+l^- + X$. Gaillard, M. K. (European Organization for Nuclear Research, Geneva (Switzerland); Paris Univ., Orsay (France); Brookhaven National Lab., Upton, N. Y.). Jun 1972. 19p. Dep. NTIS $3.00.

Some inherent experimental difficulties and a model dependent estimate of charge asymmetry for the possible observation of weak neutral currents in $pp \rightarrow l^+ + l^- + X$ interactions are discussed. One photon and one weakly coupled massive neutral boson exchange in the parton model is considered neglecting two-photon effects. (JFP)

13678 (JINR–P2-6867, pp 116-138) MODEL LEPTON–HADRON INTERACTIONS AT HIGH ENERGIES. Kunst, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13679 (JINR–P2-6867, pp 305-332) SIGMA MODEL AND FORM-FACTOR DESCRIPTION OF K_{e3} DECAY. Khelashvili, A. A. (Tbilisi State Univ., USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13680 (JINR–P2-6867, pp 417-467) PHYSICS PROBLEMS ON ELEMENTARY PARTICLE WEAK INTERACTIONS. Chuvilo, I. V. (Inst. of Theoretical and Experimental Physics, Moscow). 1972. (In Russian).

In school of high-energy physics for young scientists.

13681 SOME ASSORTED LEPTONIC PUZZLES. Pakvasa, S. (Univ. of Hawaii, Honolulu). Contract AT(04-3)-511. Curr. Sci. (India); 42: No. 13, 447-449(5 Jul 1973).

Recent speculations concerning some of the outstanding puzzles involving leptons are briefly discussed; these include the muon puzzle, the existence of heavy leptons, the $K_L \rightarrow \mu^+\mu^-$ puzzle, the lack of neutrinos from the sun, and the suppression of $\Delta S = 1$ leptonic decays of hadrons. (LBS)

13682 DEEP INELASTIC LEPTON–NUCLEON SCATTERING AND THE CORE STRUCTURE OF NUCLEONS IN THE FRAMEWORK OF THE QUARK-PARTON MODEL. Kim, B.; Rodenberg, R. (Technische Hochschule, Aachen). Progr. Theor. Phys. (Kyoto); 49: No. 1, 267-275(Jan 1973).

Assuming the integrals of the structure functions over the scaling variable $x = -q^2/2\nu$ to be finite, relations for the "parton-core" structure of nucleons are derived. These relations allow one to test the commonly used assumption about the "parton-core" of a nucleon as an equal mixture of quarks of all types and the assumptions of charge symmetry and equal distribution of the nucleon momentum among the different types of quarks. (auth)

13683 $K_1^0 \rightarrow 2\gamma$ DECAY AND W-BOSON. Ghosh, T. (M.M.C. Coll., Calcutta); Dhara, M. Progr. Theor. Phys. (Kyoto); 49: No. 2, 703-704(Feb 1973).

The mass of the charged intermediate vector boson is estimated at 2.3 GeV from $K_1^0 \rightarrow 2\gamma$ decay through the closed loop graph of $W^+W^-W^-$ bosons. It is proposed that this decay may occur at second order in the electromagnetic interaction. The estimated charged W mass is close to the experimental lower limit. (JFP)

13684 CONSTRAINTS ON CURRENT FRAGMENTS IN INCLUSIVE LEPTON SCATTERING. Roy, P. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 7: No. 5, 175-179 (2 Jun 1973).

The quark-parton description of one-particle inclusive lepton–nucleon interactions in the current fragmentation region is studied. A number of new testable constraints on the structure functions are obtained which can throw light on the question of the inconsistency of the incoherent-scattering assumption with the quark-parton description. (LBS)

13685 $\Delta I = \frac{1}{2}$ RULE IN NONLEPTONIC WEAK DECAYS. Reid, J. H.; Trofimenkoff, N. (Univ. of Calgary, Alberta). Progr. Theor. Phys. (Kyoto); 49: No. 2, 612-621(Feb 1973).

The role that final-state interactions might play in producing the $\Delta I = \frac{1}{2}$ rules in $K \rightarrow 2\pi$ and nonleptonic hyperon decays is studied. Starting from unsubtracted dispersion relations for the decay amplitudes and using elastic unitarity, integral equations of the Omnès type are obtained for the decay amplitudes. The integral equations are solved and the solutions are evaluated numerically in order to determine the effect of the final-state interactions on the decay amplitudes. The main results are: The final-state interactions are of the nature required to produce the $\Delta I = \frac{1}{2}$ sum rules for $K \rightarrow 2\pi$ and nonleptonic Λ and Σ decay amplitudes as well as to give a small parity-conserving $\Sigma^- \rightarrow n\pi^-$ decay amplitude; however, they probably also lead to a small parity-violating $\Sigma^- \rightarrow n\pi^-$ decay amplitude in contradiction with experiment. It is unlikely that final-state interactions play a role in producing the $\Delta I = \frac{1}{2}$ rule in Ξ decays. (auth)

13686 LEPTONIC DECAYS OF BARYONS. Sohn, K. S. (Kyungpook National Univ., Taegu, Korea). New Phys. (S. Korea); 12: No. 3, 89-91(Sep 1972). (In Korean).

To reverse the trend of the particle view by looking directly at the weak interactions, a new quantum number and new weak isospin were proposed, the lepton and the meson and baryon octets were rearranged, and the branching ratios of the leptonic decays of baryons were calculated by the use of this new weak isospin. (auth)

13687 GENERAL RELATIVISTIC FLUID SPHERES. VI. On Physically Meaningful Static Model Spheres in Isotropic Coordinates. Kuchowicz, B. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 3, 415-423(1973).

Physical conditions which are imposed on the matter in a static fluid sphere are expressed in terms of differential inequalities. These inequalities are relating the two functions appearing in the general formal solution (in isotropic coordinates) to such conditions as the positive definite character of density or pressure or adiabatic stability. The standardized form of the set of inequalities admits a future computer-aided study on the influence of physical conditions upon the solutions of Einstein equations. Examples of an analysis of the physical behavior of exact solutions are given. (auth)

13688 $\Delta S = 0$ AND $\Delta N' = 1$ NONLEPTONIC INTERACTION IN THE NEW NAGOYA MODEL. Hayashi, T.; Karino, T.; Matsuda, M.; Ogawa, S. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 293-303(Jan 1973).

Based on previous analyses of the possibly new particle observed by Niu's group, some detailed structure of the weak interaction is discussed in connection with the nonleptonic decay processes. The conditions imposed upon decay amplitudes when they are derived from the two-body ($\bar{p}p'$) interaction (or the 15 Hamiltonian) are presented, and also the consequence of the "configuration conservation" rule is examined. A discussion of the urbaryon "line" picture of hadrons is developed. (auth)

13689 APPLICATION OF PARAFERMION ALGEBRAS OF ORDER 2. Carey, A. L. (Univ. of Adelaide). Progr. Theor. Phys. (Kyoto); 49: No. 2, 658-666(Feb 1973).

The representation theory of SO(2N + 1) is used to analyze the structure of general representations of parafermion algebras of order 2. The results are applied to overcome a difficulty in Green's application of parastatistics to the leptons. (auth)

13690 $K_L \rightarrow \mu^+\mu^-$ DECAY AND MASSIVE AXIAL PHOTON. Miyamoto, Y. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 49: No. 1, 359-362(Jan 1973).

Under the assumption of CP conservation the contribution to the $K_2 \rightarrow \mu^+ + \mu^-$ decay of the massive axial photon or Weinberg's Z meson is investigated. It is found that the introduction of the massive axial photon gives quite a large decay rate due to the nonconservation of axial charge current. This difficulty can be avoided by analogy to PCAC theory. (JFP)

13691 INTERACTIONS OF ELEMENTARY PARTICLES IN DUAL PARTON MODEL. Miyatake, Y. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 316-321(Jan 1973).

The origins of interactions of elementary particles are analyzed with the string model of Nambu and Susskind. Strong, electromagnetic, and weak interactions originate from the different partons in the hadrons. Partons in the center of the string have nothing to do with weak interactions. (auth)

13692 SPONTANEOUSLY BROKEN GAUGE THEORIES OF WEAK INTERACTIONS AND HEAVY LEPTONS. Bjorken, J. D.; Smith, C. H. Llewellyn (Stanford Linear Accelerator Center, Stanford niversity, Stanford, California 94305). Phys. Rev. D 7: No. 3, 887-902 (1 Feb 1973).

Branching ratios and production cross sections are calculated for the heavy leptons which occur in a class of spontaneously broken gauge theories of weak interactions. Several examples of such theories are constructed. (auth)

13693 REACTION $\nu+P\to\nu+\mu^+\mu^-+P$ IN A SIX-FERMION COUPLING THEORY. Smith, J.; Stanko, N. (The Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 7: No. 3, 927-930 (1 Feb 1973).

A theory in which the hypothetical intermediate boson of weak interactions interacts strongly with hadrons becomes a theory with a six-fermion coupling in the limit that the mass of the boson is very large. To facilitate setting an upper limit on such couplings in high-energy neutrino experiments, we give here the theoretical muon spectra for the reaction $\nu+p\to\nu+\mu^+\mu^-+p$ calculated for a typical six-fermion interaction. A comparison is also made with the muon spectra predicted from V-A theory, and a rough upper limit on the coupling constant is made using data from the CERN neutrino experiment. (auth)

13694 SOME EVIDENCE AGAINST THE EXISTENCE OF SEHGAL'S LOW-MASS FERMION. Longo, Michael J. (Harrison M. Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48104); Deck, Robert T. Phys. Rev. D 7: No. 3, 917-919 (1 Feb 1973).

Sehgal has proposed that the anomalously low rate observed for the decay $K_L^0\to2\mu$ can be explained if there exists a neutral fermion λ with mass $<1/2M_K$. We discuss the relevance of a recent experiment at SLAC by Rothenberg et al. to Sehgal's proposal. We estimate that if Sehgal's hypothesis were correct, with a tantalum production target the SLAC group should have observed between 10 and 10^5 lepton pairs produced by λ interactions in their spark chambers, while in fact only 2 two-prong events were observed. This poses considerable difficulty for Sehgal's hypothesis. However, because of the uncertainty in our estimates, we do not believe it can be completely excluded. (auth)

13695 HOW MASSIVE IS THE W PARTICLE?. Schwinger, Julian (University of California at Los Angeles, Los Angeles, California 90024). Phys. Rev. D 7: No. 3, 908-909 (1 Feb 1973).

It is suggested that the mass of the hypothetical unit-spin charged particle mediating the weak interactions is ~53 BeV. (auth)

13696 SOME ABSOLUTE BOUNDS FOR K_{l3} DECAY PARAMETERS. Okubo, Susumu (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 7: No. 5, 1519-1522 (1 Mar 1973).

Assuming that the scalar [or vector] K_{l3} form factor D(t) [or $f_+(t)$] is either univalent or a function satisfying at most a once-subtracted dispersion relation with a definite sign for its imaginary part, we can derive several exact bounds for these form factors without introducing any arbitrary parameters. (auth)

13697 TESTS OF SECOND-CLASS CURRENTS IN $\Delta(1236)$ PRODUCTION BY NEUTRINOS. Brown, S. M. (Johns Hopkins Univ., Baltimore). Nuovo Cim.; 16A: No. 1, 85-101 (1 Jul 1973).

Tests are presented for the presence of second-class currents in the production of the $\Delta(1236)$-resonance by neutrinos and antineutrinos. Particularly convenient expressions are given for the six structure functions describing this process. It is shown that a knowledge of the structure function W_2 for both neutrino and antineutrino processes is sufficient to demonstrate the presence or absence of second-class currents. Prescriptions for measuring W_2 are presented. (auth)

13698 SEMI-WEAK INTERACTIONS AND THE NONLEPTONIC HYPERON DECAYS. Gavroglu, K. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 16A: No. 1, 61-68 (1 Jul 1973).

The pole model for the nonleptonic weak decays is modified by considering the three- and two-particle vertices as semi-weak interactions instead of strong and weak ones. This gives excellent agreement with experiment for both the s- and p-wave amplitudes with only the $1/2^+$ poles. The method is also applied to the $\Delta S=1$ radiative decays, and it is seen that the only experimental result (Γ and α of $\Sigma^+\to p\gamma$) can be derived through a rather interesting connection between the parameters involved in $B\to B'\pi$ and $B\to B'\gamma$. (auth)

Strong (General)

13699 (COO-3533-17) LECTURES ON DUAL RESONANCE MODELS. Part Three: Operator Formalism. Frampton, P. H. (Syracuse Univ., N. Y. Dept. of Physics). 1972. 72p. (SU-4205-17). Dep. NTIS $5.75.

The properties of the multiparticle dual amplitude are considered by fully exploiting the operator formalism. In particular, by realizing the projective group on the Fock space spanned by the harmonic-oscillator-like operators the gauge invariances of the theory are found. For the case of the unit intercept it is shown that the large gauge invariance group enables elimination of all ghost states arising from the relativistic metric. The twisting operator and the twisted propagator are introduced, and the multireggeon vertex is discussed. (JFP)

13700 (COO-3533-23) COMMENTS ON A PAPER BY KHURI. Balachandran, A. P. (Syracuse Univ., N. Y. Dept. of Physics). May 1973. 6p. (SU-4205-23). Dep. NTIS $3.00.

It is shown that the following bound is valid at any given energy: $\sigma_t\le\sigma_2+\frac{1}{2}[(2\bar{n}-5)\Sigma_0+\{(2\bar{n}-5)^2\Sigma_0^2+8(\bar{n}-2)\sigma_2\Sigma_0\}^{1/2}]$. The quantity σ_n is the cross section for the production of n particles, $\Sigma_0=\max_{n\ge3}\sigma_n$ and $\bar{n}$ is the average multiplicity. The bounds of Khuri on the Pomeranchuk intercept can be obtained from this equation under suitable assumptions on σ_2, Σ_0 and $\bar{n}$. (auth)

13701 (JINR-P2-6867, pp 91-115) SINGLE-PARTICLE SPECTRA IN MULTIPLE PRODUCTION PROCESSES. Slepchenko, L. A. (Tbilisi State Univ., USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13702 LIGHT-CONE QUANTIZATION OF DUAL MODELS AND STRUCTURE FUNCTIONS. Casalbuoni, R.; Gomis, J. (Istituto Nazionale Fisica Nucleare, Florence). Nuovo Cim; 15A: No. 4, 625-646(21 Jun 1973).

Some of the light-cone aspects of the dual-resonance models are studied and the agreement with the usual results of the light-cone analysis based on other models is shown. To accomplish this program the Lagrangian formulation of the DRM is quantized on the light-cone. The quantization procedure is based on the derivation of the completeness relation for the c-number solutions of the wave equation. An interesting result of this analysis is that the c-number solutions in configuration space form a complete set at $x^+=$ const only in the space of the functions f(x) such that $\lim_{x\to\pm\infty}f(x)=0$. From the quantization of the field the current commutators and the explicit expressions for the bilocal operators are obtained. Using such expressions are calculated the structure functions of the deep inelastic scattering up to the second order in the interaction term which reproduces the dual amplitude. It is found that $F_2(\xi)$ has the correct Regge behavior for $\xi\to0$. (auth)

13703 WHY THE PREPONDERANCE OF PIONS IN THE HIGH-ENERGY INELASTIC COLLISIONS OF HADRONS? Pavkovic, M. I. (New York Univ., NY). Lett. Nuovo Cim.; 7: No. 9, 350-352(30 Jun 1973).

An explanation is given for the violation of SU(3) symmetry at high energies in inelastic scattering of hadrons with strong dominance of pions. It is assumed that the hadrons are assemblies of quarks, and the parton model is used. It is shown that pions offer a much larger cross section area to the incoming projectiles than the kaons and other virtual particles. By displaying larger cross section areas they have a better chance of being knocked out in the act of collision. (JFP)

13704 GHOST-FREE DUAL AMPLITUDES WITH DIFFERENT EXTERNAL PARTICLES. Dullemond, C.; Vervoort, P. M. (Univ., Nijmegen, Netherlands). Lett. Nuovo Cim.; 7: No. 6, 197-200(9 Jun 1973).

It is shown that for the interaction between N identical particles, it is possible to construct dual amplitudes with one extra parameter, the mass squared of the neighboring external particles, without introducing ghosts. (JFP)

13705 EXCITATION OF HADRONIC MATTER AND H-QUANTUM. Nagaski, M.; Taketani, M. (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 49: No. 1, 368-370(Jan 1973).

The results of a calculation of sound velocity in hadronic matter are given in which the sound wave in the hadronic matter is assumed to be due to the pair excitation of nucleon and antinucleons. The no-phonon state corresponds to the pion. The values of the sound velocity and the coupling constant are shown for several values of the momentum cutoff. Also a process is considered in which many mesons with various masses are exchanged. The masses of the levels have the value $m_1=2$ GeV which is well compared with the mass of the H quantum. Thus in the present model the H-quantum corresponds to a kind of field theoretical collective mode of the excitation of hadronic matter. (JFP)

13706 AUTOMODELITY IN STRONG INTERACTIONS. Matveev, V. A.; Muradyan, R. M.; Tavkhelidze, A. N. (Joint Inst. for

Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 15: No. 3, 332-339(Jun 1973). (In Russian).

A method is proposed for studying the dynamics of strong interactions by means of generalized dimensional analysis and automodelity principle. (auth)

13707 POMERON FACTORIZATION IN GENERAL DUAL MODELS. Clavelli, L.; Shapiro, J. A. (Rutgers—The State Univ., New Brunswick, NJ). Nucl. Phys., B; B57: No. 2, 490-535(1973).

It is demonstrated that in each ghost-free dual model with one minor restriction, there exists a critical dimensionality of space-time in which the pomeron singularity becomes a factorizable Regge pole. In each model when this dimensionality is chosen, the pomeron emerges with twice the intercept and half the slope of the leading secondary (f) trajectory. The pomeron propagator and the operator coupling the pomeron to the reggeon sector for the general dual model, including the lower-lying negative-G-parity pomeron in the Neveu–Schwarz model are explicitly constructed. Gauge identities and physical states in the pomeron sector are also investigated. In all of the dual models the pomeron form factors exhibit a generalized f dominance and modified Wu–Yang behavior. (auth)

13708 TWO MODES OF INELASTICITY: EXCITATION AND DISSOCIATION. Malecki, A. (Inst. of Nuclear Physics, Krakow). Lett. Nuovo Cim.; 7: No. 5, 183-186(2 Jun 1973).

The processes of scattering and production in hadron and photon beams at high energies are discussed in a unified way. Distinction is made between the two modes of inelasticity—excitation and dissociation. Some formulas for excitation and dissociation on nuclear targets are discussed. (LBS)

13709 LOCAL FIELD THEORY OF THE DUAL STRING. Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). Nucl. Phys., B; B57: No. 2, 367-380(1973).

A (classical) local field theory is developed which contains as a special solution the (classical) dual string recently discussed by Goddard, Goldstone, Rebbi, and Thorn. The basic field is a gauge field $F_{\mu\nu}(x)$, and the Lagrangian is given by $(-\frac{1}{2}\alpha')\sqrt{F^2}$. The case of closed strings (corresponding to the Shapiro–Virasoro model) where $F_{\mu\nu}$ can be expressed in terms of potentials A_μ is treated. Quantization of $F_{\mu\nu}$ is briefly discussed, but a more thorough discussion is postponed. (auth)

13710 ABSORPTIVE CORRECTIONS AND PION-EXCHANGE CONTRIBUTIONS TO INCLUSIVE REACTIONS. Gotsman, E. (Tel-Aviv Univ., Israel); Maor, U. Nucl. Phys., B; B57: No. 2, 575-581(1973).

Pion-exchange contributions to inclusive reactions in the fragmentation domain are discussed and the importance of introducing absorptive corrections is stressed. An explicit model which incorporates the absorptive two-body correction is suggested and its experimental implications are examined. (auth)

13711 PROPERTIES OF HADRON STATES CONTAINING A CONDENSED PHASE OF QUARK–ANTIQUARK EXCITATIONS. Minkowski, P. (CERN, Geneva). Nucl. Phys., B; B57: No. 2, 557-574(1973).

It is analyzed how one-particle states can arise in a field theory of (three) quark triplets with current–current interactions which does not produce asymptotic quark states. A condensed phase of quark–antiquark pairs resembling the corresponding phase in a superconductor is responsible for the lack of stable states in the sectors with triality different from zero, provided that stable one-particle states indeed exist in the triality zero sectors, corresponding to stable configurations of valence quarks in the presence of the condensed phase. The precise dynamics of valence quarks is beyond the scope of the present model which is meant to illustrate a mechanism which prevents the basic quanta of the underlying fields to become asymptotically isolated and still eventually generates stable states in the hadronic sectors without inconsistencies. (auth)

13712 COMBINING INCLUSIVE AND EXCLUSIVE DATA ANALYSES: WHAT HAVE WE LEARNED SO FAR. Kittel, W. (European Organization for Nuclear Research, Geneva). J. Phys., A (London); 6: No. 6, 733-755(Jun 1973).

A brief summary is given of the main conclusions drawn so far from the model independent study of multiparticle production. A systematic analysis of the data leads to the observation of strong correlations, probably due to three different regimes in particle production: diffraction dissociation, central particle production, and nonvacuum exchange processes. (auth)

13713 EIKONAL METHODS AND ABSORPTIVE EFFECTS IN HADRONIC PRODUCTION PROCESSES. Neff, T. L. Stanford, CA; Stanford Univ. (1973). 106p. University Microfilms Order No. 73-14,948.

Thesis (Ph. D.).

Absorptive effects are shown to be of utility in probing the nature of hadronic interactions and in testing models for multiple production. These effects result theoretically from the imposition of full s-channel unitarity upon model assumptions which do not possess it, and reflect the influence of small-scale (in configuration space) hadron dynamics. The globally smooth properties of hadronic production (scaling, Poisson multiplicities, etc.) are the result of the innumerable competitive mechanisms involved in a complex many-body problem. The local dynamics is reflected in small effects in certain experimental distributions. These effects and others are illustrated in a heuristic parton model which also establishes the connection between the eikonal model and strong absorption. Specific model calculations are performed and the resulting nontrivial correlations induced by absorption are compared with experiment. (Diss. Abstr. Int., B)

13714 PROPERTIES OF POLARIZATION DENSITY MATRIX IN REGGE-POLE MODELS. Doncel, Manuel G.; Mery, Pierre; Michel, Louis; Minnaert, Pierre; Wali, Kameshwar C. (Institut des Hautes Etudes Scientifiques, 91-Bures sur Yvette, France). Phys. Rev. D 7: No. 3, 815-835 (1 Feb 1973).

We study two-body (or quasi-two-body) parity-conserving reactions with unpolarized beam and target. From the general considerations of angular momentum and parity conservation we derive the structure of the density matrices of the final particles. This structure becomes conspicuous when one uses transversity quantization with a special reordering for the lines and columns. We study the predictions of a single Regge trajectory exchange model. We derive the consequences of reality and factorization of residue functions, and of parity conservation at each vertex. The results are summarized in two tables. For the cases of low-spin particles we give these results in a geometrical form. As an example we plot some experimental data on Q-meson polarization. (auth)

13715 ARGUMENTS SUPPORTING A POSITIVE TWO-POMERANCHUKON DISCONTINUITY. Chew, Geoffrey F. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 3, 934-938 (1 Feb 1973).

Abarbanel's derivation of the 2-Pomeranchukon discontinuity is examined at t=0 where the physics is especially transparent. By slightly altering the significance of Abarbanel's decomposition of the total cross section, arguments are given to support the crucial and controversial assumption that his "single-fireball" vertices do not contain the 2-Pomeranchukon branch point. It is shown further how Abarbanel's discontinuity formula gives a semiquantitative realization of the Finkelstein-Kajantie requirement of small Pomeranchukon couplings if $\alpha_P(0)$ is close to 1. This demonstration, which shows that the triple-Pomeranchukon coupling g_{PP^2} is proportional to $1-\alpha_P(0)$, depends critically on the positive sign of the Abarbanel discontinuity. (auth)

13716 CHARGE TRANSFER IN HIGH-ENERGY FRAGMENTATION. Chou, T. T. (Department of Physics, University of Denver, Denver, Colorado 80210); Yang, Chen Ning. Phys. Rev. D 7: No. 5, 1425-1428 (1 Mar 1973).

Nontransference of charge is an essential aspect of the hypothesis of limiting fragmentation for infinite-energy hadron-hadron collisions. One can define experimentally a charge transfer u from one c. m. momemtum-space hemisphere to another. At finite energies, u is not zero because the fragments may "spill over" to the hemisphere. A model is discussed which yields an estimate of u. The general validity of the energy and multiplicity dependence of this estimate is then commented upon. (auth)

13717 ASYMPTOTIC BEHAVIOR OF AN ANALYTICALLY SOLVABLE NOVA MODEL. Kronenfeld, Richard (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 3, 938-942 (1 Feb 1973).

We formulate an analytically solvable version of the nova model and obtain the s dependence of single- and two-particle inclusive distributions. The nature of the singularity in the two-particle distribution at $x_1 = x_2 = 0$ and numerical predictions for National Accelerator Laboratory energies are discussed. (auth)

13718 NONLEPTONIC DECAYS WITH EXACT FIELD ALGEBRA. Gottlieb, H. P. W. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 16A: No. 1, 153-160(1 Jul 1973).

Nonleptonic decays due to a current-current interaction are considered in a nonlinear chiral Lagrangian model with a field-current identity. The apparently attractive possibility of preserving the complete chiral field algebra exactly even after the weak interactions (as well as symmetry-breaking effects for all particles) are included is shown to fail: 3-point vertices for parity-violating baryon $B \to B'\pi$ and $K \to 2\pi$ decays vanish. (auth)

13719 DEEP INELASTIC LIMIT IN A MODEL WITH REGGE CUTS. Tucker, R. W. (Univ. of Lancaster, Eng.); Zakrzewski, W. J. Nuovo Cim.; 16A: No. 1, 161-177(1 Jul 1973).

The high-energy fixed-angle limit in a dual model with Regge cuts is discussed. The model is generalized to multiparticle and inclusive processes. The hadronic deep inelastic limit of one-particle inclusive reactions is obtained and its general features discussed. (auth)

13720 DECAY OF HEAVY REGGE RECURRENCES. Antoniou, N. G.; Georgalas, C. G.; Kouris, C. B. (Democritos Nuclear Research Center, Aghia Paraskevi Attikis, Greece). Nuovo Cim.; 16A: No. 1, 135-142(1 Jul 1973).

The Brower and Harte theorem on the asymptotic behavior of infinitely rising Regge trajectories is re-examined with the effect of the resonance widths taken into account. It is found that in this case the asymptotic behavior of the trajectory is not restricted to Re $\alpha(s) \leq c\sqrt{s}$ provided that the number of decay products goes to infinity with the mass of the decaying hadron. Further implications of the inclusion of the widths are discussed. (auth)

13721 KNO SCALING AND MULTIPERIPHERAL DYNAMICS. Bassetto, A. (Univ., Padua); Pasti, P. Lett. Nuovo Cim.; 7: No. 8, 269-272(23 Jun 1973).

It is shown that the scaling function for the multiplicity distribution proposed by Koba, Nielsen, and Olesen must vanish for any value of the scaling variable $Z = n/\langle n \rangle$ larger than a suitable constant. (LBS)

13722 MULTI-PARTICLE HIGH-ENERGY REACTIONS. Ratti, S. P. (Istituto di Fisica, Milan). pp 235-279 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

The number of independent variables involved in a high-energy collision between two particles is calculated. The crucial problem of strong interactions, i.e., what happens when a large amount of energy is concentrated in a very small volume for a very short time, is discussed. Some examples of non-Monte Carlo methods and typical computer experiments are described. The search for sensitive quantities and longitudinal phase-space analysis are mentioned. (LTW)

Strong (Baryon No. = 0)

13723 (COO-3533-18) DUAL MODELS FOR FOUR MESON BORN TERMS. Balachandran, A. P.; Rupertsberger, H. (Syracuse Univ., N. Y. Dept. of Physics). Mar 1973. 13p. (SU-4205-18). Dep. NTIS $3.00.

A general formula for a dual four meson Born amplitude whose integrand is invariant under an S_3 permutation group is presented. (auth)

13724 (COO-3533-20) REGGE-SLOPE EXPANSION OF MESON BORN AMPLITUDES. Frampton, P. H.; Wali, K. C. (Syracuse Univ., N. Y. Dept. of Physics). Apr 1973. 23p. (SU-4205-20). Dep. NTIS $3.25.

The expansion, in the Regge slope parameter α', of simplified meson Born amplitudes comprising the Euler B function and its multiparticle generalization is considered in order to proceed towards a Lagrangian density L which goes beyond the zero-slope-limit of Scherk. A discussion of the Laurent-Taylor expansion of the four-meson amplitude leads, at least formally, to a Lagrangian density in terms of a scalar field ϕ; this density is, however, nonlocal since it contains an infinite number of derivatives. Certain approximation schemes, in terms of higher-mass poles of the full amplitude, are introduced. Dimensionality arguments applied also to the multiparticle extension lead naturally to the expansion of L in the Regge slope parameter, α'. The full Lagrangian density is given, up to order α'^2 relative to the zero slope limit. At this order it is necessary to consider only the four- and five-point functions. (auth)

13725 (JINR-P2-6867, pp 249-304) $\pi\pi$ INTERACTIONS AT LOW ENERGIES. Garsevanishvili, V. R. (Mathematical Inst., Tbilisi, USSR); Shirkov, D. V. 1972. (In Russian).

In school of high-energy physics for young scientists.

13726 (ORO-2504-207) DISTRIBUTION OF TRANSVERSE MOMENTUM. Glasser, R. G. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jun 1973. 3p. Dep. NTIS $3.00.

If a system is symmetric under rotations about an axis the distribution of momentum transverse to this axis may be inferred from the distribution of the momentum projected on any direction transverse to the axis. This relation is useful in dealing with the distribution of inclusive neutral pion momenta derived from inclusive γ momentum distributions. (auth)

13727 LINE REVERSAL IN BARYON EXCHANGE REACTIONS AND THE ENERGY DEPENDENCE OF DIP LOCATIONS. Barger, V. (Univ. of Wisconsin, Madison); Halzen, F.; Phillips, R. J. N. AT(11-1)-811. Nucl. Phys., B; B57: No. 2, 401-406 (1973). (COO-881-352).

An empirical investigation of $\bar{p}p \to \pi\pi$ and $\pi p \to \pi p$ data provides evidence for a dynamical variable connected with the boundary of the physical region. Absence of a fixed $u \simeq -0.2$ dip in recent $\bar{p}p \to \pi^-\pi^+$ high-energy data disagrees with nucleon-exchange (N) line-reversal expectations from $\pi^+p \to p\pi^+$ backward scattering. It is noticed however that the $\pi^+p \to p\pi^+$ dip is not located at fixed u but remains with a surprising accuracy at a fixed distance $u' = u - u_{min}$ from the physical boundary. Conjecturing that dips associated with particle exchanges occur at fixed u', it is predicted that the N-exchange dip in $\bar{p}p \to \pi^-\pi^+$ will be considerably displaced at non-asymptotic energies. The conjecture places the fixed $u' = -0.2$ dip near $u \simeq -0.4$ in $\bar{p}p \to \pi^-\pi^+$ for momenta around 2 GeV/c. Folded $\bar{p}p \to \pi\pi$ distributions exhibit a dip structure at this location. These observations suggest that the failure of line reversal at low energies is due to direct-channel effects, since u' dips occur naturally in geometrical and direct-channel models. (auth)

13728 LARGE BRANCHING RATIO OF THE $\eta \to \pi^0\gamma\gamma$ DECAY AND THE POSSIBLE EXISTENCE OF A NEW KIND OF BOSON (FUJII BOSON?) WITH MASS SMALLER THAN M_η. Matumoto, K. (Toyama Univ., Japan); Progr. Theor. Phys. (Kyoto); 49: No. 1, 363-364(Jan 1973).

The hypothesis is proposed that there exists a new kind of isoscalar vector boson U with mass μ smaller than m_η and the $\eta \to \pi^0\gamma\gamma$ decay proceeds as $\eta \to \gamma + U \to \gamma + (\gamma + \pi^0)$. The true nature of U is studied, and the hypothesis is discussed that U_μ is just the field of the composite force of hadrons which was first introduced by Fujii based on the Sakata model and J^μ_U is the triality current which is a necessary modification of Fujii's baryonic current. (JFP)

13729 NON-CONSERVATION OF THE UNITARY-SINGLET AXIAL VECTOR CURRENT AND THE POSSIBLE ROLE OF THE FUJII BOSON WITH MASS LARGER THAN $m_{\eta'}/2$. Matumoto, K. (Toyama Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 1, 35-368(Jan 1973).

A new idea is proposed concerning a possible role of the Fujii boson in the nonconservation of the unitary-singlet axial-vector current or in the symmetry breaking of chiral U(3) × U(3). The hypothesis is proposed that even though Fujii's theory of the composite force of hadrons is formally symmetric for chiral U(3) × U(3) as well as chiral SU(3) × SU(3) (except for the u term) the unitary-singlet axial vector current is not conserved. It is also found that the mass of the isoscalar vector boson U must be larger than $m_{\eta'}/2$. (JFP)

13730 POLARIZATION MEASUREMENT OF THE $\bar{p}p \to \bar{n}n$ CHARGE EXCHANGE AT 8 GeV/c. Le Du, P. (CEN, Saclay, FR); Guisan, O.; Beusch, W.; Borghini, M.; Polgar, E.; Websdale, D.; Fluri, L.; Gentit, F. X.; Astbury, P.; Gallivan, J.; Jafar, J.; Wilson, J. A. Phys. Lett., B; 44B: No. 4, 390-392(14 May 1973).

The $\bar{p}p \to \bar{n}n$ polarization was measured at 8 GeV/c and for $-t$ values ranging from 0 up to 0.8 $(GeV/c)^2$. A small and negative polarization was found. (auth)

13731 PARTIAL WAVE STRUCTURE OF THE DUAL $\pi\pi$ SCATTERING AMPLITUDE. Chung, B. K. Providence; Brown Univ. (1972). 78p. University Microfilms Order No. 73-14,548. Thesis (Ph. D.).

Contrary to claims and conjectures made earlier, it is proved that the partial waves of the dual $\pi\pi$ scattering amplitudes with isospin zero and two have an upper bound s, where s is the energy-squared variable, and those for isospin one have an upper bound $1/s$, along any ray in the asymptotic region. It is also proved that the discontinuities of the isospin zero and two partial waves diverge exponentially, but the discontinuity of isospin one partial waves is convergent. It is shown that the coefficients associated with the threshold behavior of partial waves can be calculated straightforwardly and for example, the scattering lengths for s, p, d, and f waves are given. Also different representations for the partial wave resonance widths, by which one studies the positivity conditions are given. The problem of zeros of partial waves was not touched on. (Diss. Abstr. Int., B)

13732 FURTHER REMARKS ABOUT THE ϵ (700) MESON AND BROKEN SCALE INVARIANCE. Renner, B. (II. Institut

für Theoretische Physik, der Universität Hamburg, Hamburg, Germany); Staunton, L. P. Phys. Rev. D 7: No. 3, 921-925 (1 Feb 1973).

We modify an earlier paper to remove an inconsistency in our previous approach, and we report a somewhat improved agreement between empirical sets of ($\pi\pi$) phase shifts and constraints from broken scale invariance. (auth)

13733 BOOTSTRAP OF THE VECTOR AND TENSOR MESONS USING THE EFFECTIVE-POTENTIAL METHOD. III. THE ϕ AND f. Everett, Allen E. (Department of Physics, Tufts University, Medford, Massachusetts 02155). Phys. Rev. D 7: No. 3, 903-907 (1 Feb 1973).

We use the effective potential method of Balázs, applied earlier to $\pi\pi$ and πK scattering, to calculate isospin-0 K$\bar{\text{K}}$ scattering, taking into account ρ, ω, f, and A_2 exchange, with parameters determined from experiment and SU(3), as well as ϕ exchange. We obtain self-consistent values of 1008 MeV and 0.14 for the mass and reduced width of the ϕ in the K$\bar{\text{K}}$ channel, compared with experimental values of 1020 MeV and 0.23. Using ϕ exchange with the self-consistent values of the parameters, together with the other exchanges, then yields an f meson with mass and K$\bar{\text{K}}$ partial width of 1540 MeV and 31 MeV, compared with experimental values of 1514 MeV and 53 MeV. We also correct a numerical error in the earlier K* bootstrap calculation, and make some general comments on the comparison of the pattern of vector and tensor masses and widths obtained using the method with experiment; the over-all results appear encouraging. (auth)

13734 $\pi\pi$ SCATTERING AMPLITUDE IN THE LOW-ENERGY REGION. Pennington, M. R.; Protopopescu, S. D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 5, 1429-1441 (1 Mar 1973).

Recent unambiguous experimental $\pi\pi$ phase shifts are shown to be consistent at least up to 850 MeV with crossing and analyticity requirements, using the rigorously provable integral equations of Roy. We compute the s- and p-wave phase shifts in the experimentally unknown region from threshold to 500 MeV. We find the scattering lengths $a_0{}^0 = 0.15 \pm 0.07$ and $a_0{}^2 = -0.053 \pm 0.028$. We also calculate the s-, p-, and d-wave amplitudes in the subthreshold region and show that the current algebra predictions of Weinberg are strongly supported by the data. We consider some phenomenological models which are in agreement with the data and discuss why their predictions are similar to Weinberg's. (auth)

13735 PRODUCTION OF COHERENT MIXTURES OF RESONANCES IN THE QUARK MODEL. Lipkin, Harry J. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 7: No. 5, 1561-1563 (1 Mar 1973).

The production of a coherent mixture of the f^0 and a degenerate s-wave resonance is described in the quark model by classifying the two resonances in the J = 2 and J = 0 states of the same ^3P configuration. The model predicts experimentally observed decay angular distributions, including the cancellation of the peak in the center of the d wave by s-wave interference. (auth)

13736 BARYON-ANTIBARYON BOOTSTRAP MODEL OF THE MESON SPECTRUM. Schierholz, G. (Univ., Hamburg). Nuovo Cim.; 16A: No. 1, 187-207(1 Jul 1973).

A baryon-antibaryon bootstrap model is presented which, for the meson spectrum, is understood to be an alternative of the quark model. Starting from the baryon octets, the forces are constructed from the t-channel singularities of the nearest meson multiplets and transformed into an SU_3 symmetric potential. At this stage it is assumed that the baryon and meson multiplets are degenerate. Any contributions from the u-channel are neglected for it is exotic and only contains the deuteron. The dynamical equation governing the bootstrap system is the relativistic analog of the Lippmann-Schwinger equation which is an integral equation in the baryon c.m. momentum. The potential is chosen to take account of relativistic effects. Inelastic contributions such as two-meson intermediate states are neglected. Reasons why they must be small are discussed. A search is made for self-consistent solution of the bootstrap system in which baryon-antibaryon bound-state multiplets, to be interpreted as mesons, are forced to coincide with the input meson multiplets. Furthermore, the output coupling constants and F/D ratios have, to a certain extent, to agree with their input values. Practically, it is required that the bootstrap system consists of only a few multiplets, the remainder being decoupled approximately. A self-consistent solution is found comprising scalar, pseudoscalar and vector singlets and octets with masses being in good agreement with their average physical masses. The coupling constants and F/D ratios turn out to be consistent with experiment and other ideas. Possible origins of SU_3 breaking are then investigated. The spontaneous break-down of SU_3 is ruled out by the fact that the dynamics are stable against small perturbations of the input masses. Instead, a solution of the symmetry breaking is given in terms of boot-strapped singlet-octet mixing. (auth)

13737 $\bar{p}p$ ANNIHILATION TO $\pi^-\pi^+$ AND K^-K^+. Donnachie, A. (Univ. of Manchester, Eng.); Thomas, P. R. Lett. Nuovo Cim.; 7: No. 8, 285-294(23 Jun 1973).

A model is constructed for the reactions $\bar{p}p \to \pi^-\pi^+$ and $\bar{p}p \to K^-K^+$ based on resonance-Regge pole duality plus a coherent background coming from quark re-arrangement processes. Predictions of the model are compared with polarization and forward and backward differential cross-section data. (LBS)

13738 RISING REGGE TRAJECTORIES AND MODELS OF MULTIPLE PRODUCTION. Fleming, H. (Univ., Sao Paulo, Brazil). Lett. Nuovo Cim.; 7: No. 8, 265-268(23 Jun 1973).

The decay of resonances located on rising Regge trajectories is studied for the case of meson trajectories. It is shown by combining analyticity arguments with energy and angular-momentum conservation that a high-spin resonance decays into a resonance of spin smaller by a few units plus a light particle, in a state of low orbital angular momentum. The scheme used is a natural generalization of the isobaric model. (LBS)

Strong (Baryon No. = 1)

13739 (COO-3533-15) CONSEQUENCES OF LOCAL DUALITY IN $K^-p \to \pi^\pm\Sigma^*$ (1385). Shah, P. M. (Syracuse Univ., N. Y. Dept. of Physics). Apr 1973. 14p. (SU-4205-15). Dep. NTIS $3.00.

The study of the consequences of local duality in the reactions $K^-p \to \pi^\pm\Sigma^*$ (1385) is extended. With the total widths determined in K^-N scattering, the differential cross sections for the above reactions were computed for the center of mass energy 1.7 to 1.9 GeV. Also the differential cross sections were calculated for the reactions $\pi N \to \pi\Delta$ (1236). (auth)

13740 (JINR-P2-7222) NEW TYPE OF SUM RULES FOR πN SCATTERING IN SUBTHRESHOLD REGION. Gerdt, V. P.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A series of the cross sum rules for πN-scattering, which depends on the parameter, is obtained. It is shown that the presence of the parameter in the sum rules allows one to find the constraints to the energy dependence of partial waves which follow from the crossing-symmetry conditions. (auth)

13741 POSSIBLE BARYON CONSERVATION FROM QUATERNION CHARGE. Edmonds, J. D. Jr. (Oregon State Univ., Corvallis). Lett. Nuovo Cim.; 7: No. 10, 398-400(7 Jul 1973).

It is suggested that the ring of complex quaternions be the basic number system for relativistic quantum physics. The quaternion charge is discussed, and it is suggested that baryon conservation may be connected with the quaternion charge. Experimental tests are also suggested. (LBS)

13742 RELATION AMONG TOTAL CROSS SECTIONS OF MESON-BARYON SCATTERING. Yoshida, T. (Fukushima Univ., Japan). Lett. Nuovo Cim.; 7: No. 5, 171-172(2 Jun 1973).

It is shown that the deviation of the predictions of the Barger-Rubin relation on total cross sections of meson-baryon scattering from Serpukhov data can be explained in consideration of shadow scattering of inelastic processes in relation to the quasi-two-body mechanism in the quark-line picture. (LBS)

13743 ANALYSIS OF CHARGE MULTIPLICITY DATA AT HIGH ENERGIES. Grard, F.; Herquet, Pl.; Laurent, J.; Schlesinger, J.; Windmolders, R. (Univ., Mons, Belg.). Nucl. Phys.; B57: No. 2, 407-412(1973).

The mode and the median charged multiplicities are both found to exhibit a similar increasing linear dependence of ln Q for pp, $\pi^\pm$p and $K^\pm$p interactions in the interval $1 < \ln Q < 3$ (Q = available cm energy in GeV). The values obtained are compared to the predictions of the Nova model and the Chew-Pignotti model. (auth)

13744 ATTEMPT TO INTRODUCE NUCLEON SPIN IN THE RELATIVISTIC EIKONAL MODEL. Humpert, B.; Quiros, M. (Univ., Geneva). Lett. Nuovo Cim.; 7: No. 6, 201-205(9 Jun 1973).

A discussion is given of the modification if the nucleon in $\pi + N \to \pi + N$ interactions is treated as a spin-½ particle in the eikonal model in potential theory. These results are the first step towards a completely factorized eikonal amplitude with nucleon spin. (JFP)

13745 ASYMPTOTIC BEHAVIOUR OF FERMIONIC TRAJECTORIES. Fleming, H. (Univ., Sao Paulo, Brazil). Lett. Nuovo Cim.; 7: No. 6, 209-212(9 Jun 1973).

It is shown how it is possible to extend to the fermionic case some results about the asymptotic behavior of Regge trajectories and widths previously obtained for the mesonic case. (JFP)

13746 ROLE OF DIFFRACTIVE EXCITATION MECHANISM IN MULTIPLE PRODUCTION OF HADRONS. Uehara, M. (Kyushu Univ., Fukuoka). Progr. Theory. Phys. (Kyoto); 49: No. 1, 227-241(Jan 1973).

The role of the diffractive excitation mechanism is examined; the rate of total diffractive cross section is estimated to be about $\frac{1}{3}$, at most, of the total inelastic πN cross section at 16 GeV/c. A large nondiffractive production mechanism is needed. The behavior of the average multiplicity and its dispersion are discussed in the case that the diffractive and nondiffractive mechanism coexist. A simple model with a pomeron as a fixed pole is given, which is normalized absolutely so that it reproduces experimental low mass spectra approximately. A single pion distribution function is also discussed. (auth)

13747 SINGLE PARTICLE DISTRIBUTIONS IN THE SMALL X REGION. Sakai, S. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 49: No. 2, 552-561(Feb 1973).

Single particle distributions are investigated in the multiperipheral model. The result says that in the small x region ($|x| \leq 0.2$), the distribution functions depend on $m_a^2 x^2\theta(x)$ $(m_b^2 x^2\theta(-x))$ and $m_c^2 + k_\perp^2$, where a(b) is the projectile (target) and c is the detected secondary. The x- and $k_\perp^2$-dependences of the distribution functions are more sensitive for smaller m_c^2 and larger $m_a^2(m_b^2)$. These features are supported by experimental data, and the model fits the data on both the transversal and longitudinal momentum distributions in the following collisions quite well: $\pi^+ + p \rightarrow \pi^- +$ "X", $K + p \rightarrow \pi +$ "X", $p + p \rightarrow \pi +$ "X", $\gamma + p \rightarrow \pi +$ "X", $p + p \rightarrow K +$ "X", $K^+ + p \rightarrow K^0 +$ "X", $K^- + p \rightarrow \bar{K}^0 +$ "X" and $\gamma + p \rightarrow K +$ "X". The K/π ratio becomes 0.11, which is also in good agreement with the present experimental results. (auth)

13748 URBARYON REARRANGEMENT AND THE BREAKING OF LINE REVERSAL RELATIONS. I. Matsuoka, T.; Sawada, S. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 2, 562-572(Feb 1973).

From the standpoint of urbaryon rearrangement, the breaking of line reversal relations is examined for the s-channel helicity flip and nonflip amplitudes for meson-baryon scattering, respectively. It is shown that in the s-channel helicity flip amplitude the breaking converges near $P_L = 5$ GeV/c (incident laboratory momentum), whereas it does not in the nonflip amplitudes up to $P_L \sim 20$ GeV/c. It becomes evident that this situation is shared in common by both strangeness nonexchange and exchange processes. A discussion of the relation between the breaking of line reversal relations and the composite structure of hadrons is also presented. (auth)

13749 DETERMINATION OF THE FORWARD K^+p B AMPLITUDE AND THE HYPERON COUPLING CONSTANTS. Pietarinen, E. (Research Inst. for Theoretical Physics, Helsinki); Knudsen, C. P. Nucl. Phys.; B57: No. 2, 637-645(1973).

From the K^+p forward B amplitude a new amplitude is constructed in such a way that its imaginary part can be calculated from the K^+p polarization data. A prediction of the B amplitude is obtained and the hyperon coupling constants are determined with the result $(G^2_{N\Lambda K} + 0.8G^2_{N\Sigma K})/4\pi = 1.2 \pm 2.5$. (auth)

13750 STRONG DECAY RATES OF BARYON RESONANCES IN A TWO BODY COMPOSITE BARYON MODEL. Ono, S. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 573-585(Feb 1973).

The two-body composite model of baryons, is used to calculate the strong decay rates: baryon resonance $\rightarrow$ baryon (or baryon resonance) + pion. The predicted rates agree well with experimental ones except for the Λ-resonances (I = 0, Y = 0). (auth)

13751 HELICITY CONSERVATION AND THE DRELL–HIIDA–DECK EFFECT. Kagiyama, S. (Fukuoka Univ.); Uehara, M. Progr. Theor. Phys. (Kyoto); 49: No. 1, 216-226(Jan 1973).

Coexistence of the Drell–Hiida–Deck effect and true A_1 resonance production fairly explains the complicated experimental situation that angular distributions of the normal to the decay plane appear as if the t-channel helicity were conserved but those of the ρ meson coming from the decay seem not to conserve the t-channel helicity. It is shown that the true A_1 resonance conserves the t-channel helicity and its decay into the $\rho\pi$ state occurs through the d wave dominantly. The angular distributions by the Drell–Hiida–Deck effect are studied also for the $\pi^+\pi^-p$ state diffractively produced. Conclusions similar to those for the A_1 mass region hold for the low mass $\pi^+\pi^-p$ system. (auth)

13752 LEADING LIGHT-CONE SINGULARITIES AND HADRON COLLISIONS. Iizuka, J.; Okamura, H. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 622-633(Feb 1973).

The contribution from the leading light-cone singularities to the total cross sections for γ-hadron and vector meson-hadron collisions is studied by applying the Fourier transformation with time-like momenta to the known part of the current commutator function near the light-cone. The spectral function introduced in the modified causal function is favored to have a broad spectrum with a finite support. A similar analysis is also made for pseudoscalar meson-hadron collisions. In all cases, the contribution has a common form of structure functions times the spectral function and represents a major part of the continuum in the nondiffractive component. Based on this result, a unique division of the nondiffractive component into the continuum and the resonance-dominated part is suggested in contrast to the duality approach. (auth)

13753 PHASE-SHIFT ANALYSIS OF $\pi N \rightarrow K\Sigma$. Langbein, W.; Wagner, F. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Phys.; B53: No. 1, 251-267(1973).

An energy-independent phase-shift analysis of $\pi N \rightarrow K\Sigma$ was performed by analyzing differential cross-section and polarization data for the reactions $\pi^+p \rightarrow K^+\Sigma^+$ and $\pi^-p \rightarrow K^0\Sigma^0$ at fifteen energies from threshold to 2137 MeV invariant mass. The single-energy solutions were linked by shortest-path methods with and without constraints implied by the Odorico zeros for the reactions $\pi^-p \rightarrow K^+\Sigma^-$. Similar to $\pi^-p \rightarrow K\Lambda$ it was found that both isostates are dominated below 1900 MeV by resonances in the spin $\frac{1}{2}$ waves. The F_{37} resonance couples to $K\Sigma$ with $\sqrt{x_{\pi N} x_{K\Sigma}} = 0.04$. (auth)

13754 PARTIAL WAVE ANALYSIS AND BARYON RESONANCES. Donnachie, A. (Univ. of Manchester, Eng.). Rep. Progr. Phys.; 36: No. 6, 695-753(1973).

This review is concerned with the analysis and interpretation of meson-baryon scattering at center-of-mass energies of less than 2.25 GeV/c^2 or, correspondingly, laboratory momenta of less than 2.0 GeV/c. The subject primarily under discussion is that of resonances. The concept of a resonance in the context of scattering is discussed, methods of partial wave analysis are outlined and the technique of extracting resonance information detailed, that is, first establishing the existence of resonances and secondly determining their parameters (position, total width and partial width for the channel being investigated). The classification of the resonances within SU(3), SU(6) and the quark model and the success of SU(3) in relating their partial widths is described. An important aspect of this is the question of the meson-nucleon coupling constants, and a section is devoted to their determination using dispersion relations. (auth)

13755 IMPACT PARAMETER ANALYSIS OF $\bar{K}N$ AND πN SCATTERING IN THE INTERMEDIATE ENERGY REGION. Fukugita, M. (Tokyo Univ.); Inami, T. Nucl. Phys.; B57: No. 2, 543-556(1973).

The s-channel-helicity partial-wave amplitudes for $\bar{K}N$ and πN scattering were evaluated as functions of the impact parameter using partial-wave data in the energy range $P_L \approx 1.0$ to 2.0 GeV/c. It is found that the $\bar{K}N$ background and resonance amplitudes exhibit features consistent with the dual absorptive picture for pomeron and $f + \omega$ and $A_2 + \rho$ exchanges. Comparison of the πN low-energy amplitude with the partial-wave decomposition of a quantitative Regge model gives evidence for local duality between the s-channel resonance and t- and u-channel Regge exchanges. (auth)

13756 IS THERE ANOMALOUS ISOSPIN BREAKING IN THE $\pi N \rightarrow \pi N$ S-WAVE? Laurikainen, P.; Toernqvist, N. A. (CERN, Geneva). Lett. Nuovo Cim.; 7: No. 7, 237-244(16 Jun 1973).

A phase shift analysis of $\pi N \rightarrow \pi N$ data at 300 to 600 MeV is performed to see if there are indirect effects of electromagnetic origin which contribute to anomalous isospin breaking and to see in which partial waves they occur. The results of various fits to the data suggest anomalous isospin breaking in the S-wave. (LBS)

13757 INTERSECTING REAL REGGE TRAJECTORIES IN $\pi^-P \rightarrow \pi^0N$ AND THE ρ' PUZZLE. Leader, Elliot (Westfield College, London N. W. 3, England); Nicolescu, Basarab. Phys. Rev. D 7: No. 3, 836-846 (1 Feb 1973).

A new and very simple interpretation of the reaction $\pi^-p \rightarrow \pi^0n$ based on intersecting, real, ρ and ρ' Regge trajectories is proposed. The most dominant physical features of the differential cross section and polarization data directly determine the main characteristics of the ρ', which turn out to be completely different from those based on a belief in parallel trajectories. The ρ' trajectory thus determined is compatible with the recently discovered spin-one resonance of mass 1968 MeV. (auth)

13758 ESTIMATE OF THE σ TERM IN $K^{\pm}$-P SCATTERING. Nasrallah, N. F. (Faculty of Education, Lebanese University, Lebanon); Schilcher, K. Phys. Rev. D 7: No. 3, 810-814 (1 Feb 1973).

The σ term in K-p scattering is calculated using on-mass-shell dispersion relations, available data on the $K^{\pm}p$ total cross sections, and real parts of the forward scattering amplitude. The subthreshold contribution is minimized by introducing a factor which vanishes at the $Y_{0,1}^*$ peaks; this also yields information on the $Y_{0,1}^*$pK coupling constants. Our result $\sigma^{Kp} \approx 160$ MeV is rather insensitive to the choice of the ΛpK and ΣpK coupling constants. Within the (3, 3*)+(3*, 3) model our value for σ^{Kp} favors small values of $\sigma^{\pi p}$. (auth)

13759 EIKONAL INTERPRETATION OF THE DECK EFFECT. Pumplin, Jon (Physics Department, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. D 7: No. 3, 795-798 (1 Feb 1973).

The Deck model for diffraction dissociation is revised to satisfy an eikonal representation. The theory is applied unsuccessfully to the A_1 enhancement in $\pi^-p \to \rho^0\pi^-p$. The conventional double-Regge model of this reaction is shown to be inadequate also. Further direction are suggested. (auth)

13760 EXTENSION OF A BOOTSTRAP MODEL OF INCLUSIVE REACTIONS. Kronenfeld, Richard; Peccei, R. D. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 5, 1556-1560 (1 Mar 1973).

We extend the bootstrap model of inclusive reactions proposed by Finkelstein and Peccei and by Krzywicki and Petersson to include quantum numbers. In this extended model we obtain matrix integral equations for the inclusive distribution functions in terms of leading-particle distribution functions. The single-particle inclusive distributions in the central region are found, in the model, to be independent of the process. Furthermore, if the target (projectile) leading-particle distributions are independent of the projectile (target), then all inclusive distributions in the target (projectile) fragmentation region are independent of the projectile (target) and multiparticle inclusive distributions exhibit factorization properties among particles traveling in opposite directions. An example involving the scattering of mesons and baryons is discussed. (auth)

13761 POSSIBLE EXISTENCE OF A NEW ABSORPTION EFFECT IN DUAL ABSORPTIVE MODEL AND THE STRUCTURE OF πN HELICITY AMPLITUDE. Masuda, Naohiko (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. D 7: No. 5, 1474-1480 (1 Mar 1973).

A possible new absorption effect in Harari's dual absorptive model is suggested and calculated in order to study the amplitude structure of pion-nucleon scattering. It is predicted that the imaginary part of the $I_t=1$, s-channel helicity-nonflip amplitude does not have the second zero near $|t|=0.8$ (GeV/c)^2, although the same amplitude in the original dual absorptive model has such a zero due to the second zero of the Bessel function of the zeroth order in addition to the crossover zero at $|t| \simeq 0.15$ (GeV/c)^2. This result is consistent with those of the recent analytic amplitude analysis by Kelly and of the model-independent amplitude analysis by the Saclay group. (auth)

13762 SEARCH FOR Q PRODUCTION IN CHARGE-EXCHANGE REACTIONS. Werner, B.; Slattery, P.; Ferbel, T. (University of Rochester, Rochester, New York 14627). Phys. Rev. D 7: No. 5, 1275-1279 (1 Mar 1973).

The low-mass $K\pi\pi$ enhancement (the Q effect) has been observed in $K^{\pm}N$ interactions only in the same charge state as the incident beam particle. The lack of observation of the Q in reactions involving nucleon charge exchange has been cited as evidence for the diffractive nature of Q production. We have searched for Q^0 and Q^{++} production in $K^{\pm}$ induced reactions by combining relevant world data. We have also carried out a double-Regge exchange calculation in order to estimate the magnitude of the expected signal for Q production in charge-exchange processes. (auth)

13763 CHARACTERISTICS OF MULTIPION PRODUCTION AT 3.9 AND 11.9 GEV/C. Johnson, A. D.; Peters, M. W.; Stenger, V. J.; Wohlmut, P. G.; Yee, A. (University of Hawaii, Department of Physics and Astronomy, Honolulu, Hawaii). Phys. Rev. D 7: No. 5, 1314-1324 (1 Mar 1973).

A quasi-two-body model based on one-particle exchange and diffraction dissociation has been fitted to data from π^-p interactions at 3.9 and 11.9 GeV/c in which a nucleon and 3-6 pions are present in the final state. It is used to estimate partial cross sections for the dominant resonances which are produced at these energies. The energy dependence of the cross sections is examined and found to be consistent with expected behavior, and reactions are compared and found to agree with simple factorization. (auth)

13764 MODIFIED PHASE-SHIFT ANALYSIS OF THE I=0 K-N SYSTEM AND THE EXISTENCE OF EXOTIC BARYON RESONANCES. Aaron, R. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544); Rich, M.; Hogan, W. L.; Srivastava, Y. N. Phys. Rev. D 7: No. 5, 1401-1406 (1 Mar 1973).

We have performed a modified phase-shift analysis of the Y=2, I=0 K-N system and find convincing evidence for exotic resonances in the $D_{3/2}$ and either $S_{1/2}$ or $P_{1/2}$ states. Using finite-energy sum rules, we further show that, contrary to popular notions, our results are consistent with the degree of exchange-degeneracy breaking allowed by the present experimental data. (auth)

13765 QUESTION OF BLACKBODY RADIATION IN INCLUSIVE REACTIONS IN THE WEE-χ REGION. Hwa, Rudolph C.; Robertson, David C. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 7: No. 5, 1469-1474 (1 Mar 1973).

The one-particle distribution function in the wee-χ region is derived in the diffractive-excitation model. The result describes very well the "isotropy" and "Bose-Einstein" distribution of the 11.8-GeV/c K^+p data on inclusive reactions in that region. There is no need for the postulation of "blackbody radiation." It is shown that the phenomenon should disappear at asymptotic energies. (auth)

13766 NONVANISHING CROSS SECTION FOR THE REACTION $\pi^+N^- \to (\pi^+\pi^-)N$ AT T=0. Hagopian, S.; Hagopian, V.; J. D. Kimel; Pewitt, N. D. (Department of Physics, Florida State University Tallahassee, Florida 32306); Selove, W. Phys. Rev. D 7: No. 5, 1271-1275 (1 Mar 1973).

It is shown from experimental data that the the extrapolated cross section for the reaction $\pi^-p \to \pi^-\pi^+n$ at 2.3 GeV/c is not only nonzero at t=0, but negative. This is in contrast with higher-energy results where the cross section at t=0 is positive. One-pion-exchange calculations modified by absorptive corrections give results in general agreement with these experiments. (auth)

13767 ARE REGGE AND OPTICAL MODELS EQUIVALENT, BY AN AMPLITUDE ROTATION?. Hendry, Archibald W. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 7: No. 3, 910-912 (1 Feb 1973).

By comparing with the experimentally determined amplitudes for πN scattering at 6 GeV/c and $|t| \lesssim 1$ (GeV/c)^2, we show that the Barger-Phillips Regge amplitudes are related to optical-model amplitudes by a simple rotation. This demonstrates an important connection between a dynamical model and an essentially geometric one. (auth)

13768 QUARK-MODEL COMPARISONS WITH $\rho^0\Delta^{++}$ AND $\omega\Delta^{++}$ DATA AT 3.7 GEV/C. Abrams, G. S.; Barnham, K. W. J. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley California 94720). Phys. Rev. D 7: No. 5, 1395-1400 (1 Mar 1973).

Data for the channels $\pi^+p \to \rho^0\Delta^{++}$ and $\pi^+p \to \omega\Delta^{++}$ at 3.7 GeV/c are compared with the quark-model constraints of Białas and Zalewski. The class A and B predictions are found to be valid as functions of momentum transfer for both channels. The predictions of Class C are found to fail in both s- t-channel coordinate systems. It is shown for both reactions that no reference frame exists for which all the class C relations are valid. (auth)

13769 MODEL OF THE PION-POMERANCHON CUT BASED ON THE MANDELSTAM DIAGRAM. Chia, Swee-Ping (Physics Department, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. D 7: No. 5, 1496-1514 (1 Mar 1973).

The pion-Pomeranchon Regge cut is calculated from the Mandelstam diagram, using Gribov's approach. Explicit calculations are made for three representative π-exchange processes: $np \to pn$, $\pi^-p \to \rho^0n$, and $\pi^+p \to \pi^0\Delta^{++}$. Pomeranchon exchange is assumed to be mediated by an isoscalar scalar σ meson. Convergence of the loop integrals is ensured by inserting form factors to relate the off-shell pion-exchange amplitudes to known on-shell behavior. Parameters in the model are: the mass of the σ meson, its coupling constants, and cutoff masses in the form factors. Excellent agreement with the data is obtained over a fairly wide range of energy. The model extrapolates well to t=-0.1 GeV^2 although the parameters are obtained from a fit to much smaller values of t ($|t| < 0.1$ GeV^2). Some characteristics of the πP cut can be deduced from the results. It is self-conspiratory, a feature which is essential to account for the sharp forward spike in $np \to pn$. It does not contribute to amplitudes with unnatural parity and unnatural charge-conjugation parity in the t channel. Furthermore, the cut contribution to amplitudes with natural parity in the t channel are strong only if the amplitudes have double helicity flip in the s channel. (auth)

13770 FINITE-ENERGY SUM RULES FOR FIVE-POINT AMPLITUDES. Humble, S. (Daresbury Nuclear Physics Laboratory, Daresbury, Near Warrington, Lancashire, England). Phys. Rev. D 7: No. 5, 1523-1536 (1 Mar 1973).

Finite-energy sum rules (FESR'S) for single-particle production

amplitudes are derived by considering the analytic structure of all orders of Feynman diagrams. Keeping only the bound-state pole terms in the rules, the suppression of exotic exchanges leads to the relation for the πN scattering lengths, $2a_{\frac{1}{2}} + a_{\frac{3}{2}} \approx 0$. A preliminary partial-wave analysis of the low-energy production data is also described. The results of this analysis in the FESR'S strongly support the hypothesis of duality for production processes. (auth)

13771 STRUCTURE OF THE INELASTIC OVERLAP FUNCTION FOR πp COLLISIONS IN A DIFFRACTION DISSOCIATION MODEL. Ajduk, Z. (CERN, Geneva). Nuovo Cim.; 16A: No. 1, 111-123(1 Jul 1973).

Modified nova models of diffraction dissociation, including growing spin values of the fireballs and specific helicity structures of the amplitudes, are used to analyse the inelastic overlap function F(s, t) for πp collisions at s = 10, 30, 50 $(GeV/c)^2$. The effect of the spins on the small-|t| slope of F(s, t) is found to be large. With reasonable parameters and the assumption of t-channel helicity conservation these spin effects enable the model to reproduce the slope of F(s, t) as calculated from the general optical theorem and the knowledge of elastic scattering. (auth)

13772 COMPARISON BETWEEN PHASE-SHIFT ANALYSIS AMPLITUDES AND HIGH ENERGY AMPLITUDES IN πN CHARGE EXCHANGE. Gabarro, J.; Pajares, C. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim.; 16A: No. 1, 37-46(1 Jul 1973).

A comparative study of the new phase-shift amplitudes and the high-energy amplitudes is done. The behavior of the modulus of the phase-shift amplitudes at $\sqrt{s}$ = 2.2 GeV/c is very similar to the amplitude analysis of Halzen and Michel at 6 GeV/c, but the phases of the amplitudes are different. The dependence on t of the two new phase-shift analyses presents some difference. The imaginary part of the spin-flip s-channel helicity amplitude for the Saclay phase shift has just the $J_1(r\sqrt{-t})$ form at $\sqrt{s}$ = 2.2 GeV/c. The continuous-momentum sum rules are also studied with this new phase-shift analysis, and the Harari-Freund hypothesis is tested. (auth)

13773 POMERON AND P′ EXCHANGE AMPLITUDES FOR $\pi - N$ SCATTERING. Karasuno, T.; Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 7: No. 8, 273-276(23 Jun 1973).

The properties of the pomeron (P) and P′ exchange amplitudes for π N scattering are studied using various models. (LBS)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 13455 and 13998.

13774 (COO-3533-21) REGGE ANALYSIS OF CORRELATIONS IN THE CENTRAL PLATEAU. Amann, R. F.; Geer, K. (Syracuse Univ., N. Y. Dept. of Physics). May 1973. 9p. (SU-4205-21). Dep. NTIS $3.00.

Recent experimental data on correlations in the central plateau are shown to be consistent with a simple Mueller Regge analysis. The charge dependence of these correlations is in remarkable agreement with both that expected from an extension of the Regge analysis of single particle production and from charge conservation sum rules. Predictions for the charge dependence of K-π correlations are made. (auth)

13775 (DESY-73/12) ISR RISING CROSS SECTION AND FINITE ENERGY EFFECTS IN THE POMERANCHUK MECHANISM. Craigie, N. S.; Preparata, G. (Deutsches Elektronen Synchrotron, Hamburg (West Germany)). Apr 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

It is suggested that the trends in the high energy cross section at small t can be understood in the framework for the Pomeranchuk mechanism proposed by Gribov. (auth)

13776 (JINR-P2-6867, pp 335-373) COHERENT PRODUCTION OF MULTIPION FINITE STATES IN π^4 INTERACTIONS ON NUCLEI. Salukvadze, R. G.; Khubua, D. I. (Tbilisi State Univ., USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13777 (JINR-P2-6867, pp 374-388) CUMULATIVE MESON PRODUCTION. Baldin, A. M.; Gerasimov, S. B.; Giordenesku, N.; Zubarev, V. N.; Ivanova, L. K.; Kirillov, A. D.; Kuznetsov, V. A.; Moroz, N. S.; Radomanov, V. B.; Ramkhin, V. N.; Stavinskii, V. S.; Yatsuta, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13778 HYPERON-NUCLEON SCATTERING. II. Anomalous Thresholds. Liu, Y. C. (Univ. of Nijmegen, Netherlands). Nucl. Phys., B57: No. 2, 461-489(1973).

The discontinuities across the anomalous cuts in the s-channel of $\Sigma N \to \Sigma N$ and $\Sigma N \to \Lambda N$ are calculated, using (i) the method of analytic continuation of m^2 in the unitarity formula due to Mandelstam and Gribov, and (ii) the Cutcosky rule. The result should be useful for a more rigorous treatment of hyperon-nucleon scattering in the low-energy region, in particular, for the N/D formalism in the presence of anomalous thresholds. (auth)

13779 COMMENTS ON THE EXCLUSIVE LIMIT OF INCLUSIVE PROCESSES. Perez, M. A. (Instituto Politechico Nacional, Mexico City). Lett. Nuovo Cim.; 7: No. 10, 391-394(7 Jul 1973).

The differential cross section for the exclusive processes $p + p \to p + p$ and $p + p \to p + N^*$ at high energies and wide angles is obtained in the dual resonance model. The result was found to be inconsistent with the universal behavior obtained in a previous study by Ball and Pinsky (Phys. Rev. Lett. 27, 1820(1971)). (LBS)

13780 ENERGY DEPENDENCE OF THE CROSS SECTION IN THE DECK TYPE MODELS. Cichy, A. (Jagellonian Univ., Krakow). Acta Phys. Pol; B4: No. 3, 425-430(1973).

The energy dependence of the cross section for the diffractive production in the Deck type models is studied. For the reaction $pp \to pn\pi^+$ the cross section decreases with the energy and its dependence on incident momentum can be reasonably represented as $a + bp^{-\alpha}$. (auth)

13781 SIMPLE MODEL OF THE $pp \to p$ INCLUSIVE PROCESS AT HIGH ENERGY AND SMALL x. Squires, E. J.; Webber, D. M. (Univ. of Durham, Eng.). Lett. Nuovo Cim.; 7: No. 6, 193-196(9 Jun 1973).

It is shown that the rapid scaling in the process $p + p \to \bar{p}$ + anything, being exotic in all three channels, agrees with what is expected on the basis of simple kinematics. The double Regge exchange models in which a $\bar{p}p$ pair is created at the central vertex is used. The inclusive cross section as a function of transverse momentum and energy is shown at 0.65 to 1500 GeV/c. (JFP)

13782 EVIDENCE AGAINST DIFFRACTIVE FACTORIZATION. Teper, M. (Westfield Coll., London). Lett. Nuovo Cim.; 7: No. 5, 807(2 Jun 1973).

Factorization of the diffractive exchange is used to predict the slope for $pp \to N^*N^*$, using recent data at 24 GeV/c. It is predicted that either the differential cross section for diffractive production of two high-mass resonances rises as |t| increases (for $|t| \lesssim 1$ and intermediate energies) or the diffractive exchange does not factorize. The importance of performing double-resonance production experiments is emphasized. (LBS)

13783 CAUSALITY IN THE $\pi N\Delta$ INTERACTION. Tait, W. (Queen Mary Coll., London). Lett. Nuovo Cim.; 7: No. 10, 368-370(7 Jul 1973).

A manifestly covariant derivation is given of the characteristic surface of the equations of motion for the classical fields describing the $\pi N\Delta$ system, with the requirement that the pion field is constrained to satisfy its Lagrangian equation of motion. (LBS)

13784 DIFFRACTION AND PRODUCTION OF UNCORRELATED PAIRS OF RESONANCES IN HIGH MULTIPLICITY REACTIONS. Hayot, F.; Morel, A. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 7: No. 6, 221-226(9 Jun 1973).

A model is presented which accounts for experimental facts using only two physically meaningful parameters, one the average number of charged secondaries is given. The p + p scattering is considered. It is supposed that besides two nucleons the final state contains essentially pions produced partly by fragmentation of the projectile and target and partly by some multiperipheral mechanism. The ratio for charges secondaries as a function of energy, the correlation coefficient for negative secondaries as a function of energy, and the correlation between π^0's and π^-'s at 205 and 1400 GeV/c $\sqrt{s}$ = 53 GeV are found and compared with experimental data. (JFP)

13785 CORRELATIONS BETWEEN NEUTRAL AND CHARGED PIONS IN THE TWO-COMPONENT PICTURE OF MULTIPARTICLE PRODUCTION. Robertson, D.; Sakai, N. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Lett. Nuovo Cim.; 7: No. 6, 227-231(9 Jun 1973).

The data in the two-component picture of multiparticle production are examined, and in order to help distinguish between models, the measurement of a complementary correlation parameter is suggested. The σ-type pairs ($\pi^+\pi^-$, $\pi^0\pi^0$) and ρ-type pairs

($\pi^+\pi^0$, $\pi^-\pi^0$, $\pi^+\pi^-$) are considered for p + p interactions at 205 GeV. The probability distribution for each type of pion pairs is found. It is concluded that the ISR data favor the emission of ρ-type pion pairs. Another correlation parameter complementary to the above parameter is also suggested. (JFP)

13786 REMARKS ON THE REGGE-LIKE BEHAVIOR OF THE ONE-BOSON EXCHANGE AMPLITUDE IN LOW-ENERGY NUCLEON–NUCLEON SCATTERING. K-Matrix Method. Susuki, Y. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 541-551(Feb 1973).

For the nucleon–nucleon scattering amplitudes at low energies, Regge-like behavior is studied using the K-matrix unitarization method. The Regge-like behavior is phenomenologically represented by the energy dependence of the coupling constant and mass of the exchanged boson in the one-boson-exchange (OBE) amplitudes. This behavior is shown to be likely for the vector-meson-exchange part. It is consistent with the results of an earlier analysis in terms of the partial wave dispersion relation. For the scalar meson, however, no strong evidence is found for such a behavior and its behavior is not inconsistent with cut or fixed pole. (auth)

13787 RELATIVISTIC EIKONAL APPROXIMATION AND VECTOR MESON EXCHANGE EFFECT. Doi, M.; Kotani, T. (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 242-255(Jan 1973).

The real part of the forward amplitude for high energy hadron-hadron elastic scattering is estimated from quantum field theory by means of a functional derivative method. If the generalized crossed ladder diagrams are taken into account, it is shown that the relativistic scattering amplitude can be treated in a way similar to the eikonal approximation of the nonrelativistic potential scattering. A massive vector meson is assumed to be exchanged between two colliding particles. Comparison with the p-p scattering data is discussed. (auth)

13788 HELICITY-AMPLITUDE DESCRIPTION OF LOW-ENERGY NUCLEON–NUCLEON SCATTERING. Kawasaki, M. (Hiroshima Univ.); Watari, W.; Yonezawa, M. Progr. Theor. Phys. (Kyoto); 49: No. 2, 531-540(Feb 1973).

The s-channel helicity amplitudes for t-channel isospin eigenstates are constructed in the elastic region from phenomenological nucleon-nucleon potentials. The features of the resulting amplitudes are discussed in connection with high energy amplitudes. Effects of the differences of short-range forces in the potentials are examined. (auth)

13789 MULTIPLE QUARK SCATTERING AND THE CHANGING SLOPE OF $d\sigma/dt$ IN THE SMALL $|t|$ REGION. Klenk, K. F. (Lehigh Univ., Bethlehem, PA); Kanofsky, A. S. Phys. Lett.; 44B: No. 4, 383-386(14 May 1973).

The changing slope of $d\sigma/dt$ at small $|t|$ observed in the CERN-ISR p-p scattering data can be reproduced in the Glauber multiple quark scattering model by a quark-quark scattering amplitude that is an undamped rapidly oscillating function of momentum transferred to the quark. (auth)

13790 NUCLEAR REACTIONS AT HIGH ENERGY. Berry, George W. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). Phys. Rev. D 7: No. 5, 1441-1457 (1 Mar 1973).

In the quark model, nuclei ($B \leq 2$) have exotic quantum numbers. Given a nuclear reaction in which certain quantum numbers are exchanged, what is the scattering amplitude at high energies, in the GeV region? Does it have Regge behavior? Is it dual? Are there multibaryon resonances? In this context we present a general survey of all high-energy nuclear reactions—mainly those involving light nuclei. For B=0 exchange reactions, Like πd–πd and π–h–π^0t (h≡^{3}He, t=^{3}H), there is the impulse and rescattering (Glauber) model. For B=1 exchange we discuss the one–pion–exchange (OPE) model for pp–dπ^+, pd–dp, and γd–pn, and the "knock-on" model for pd–π^+t, dd–^{4}p, dh–hd, γh–pd, and $\gamma\alpha$–pt. In the case of B=2 exchange we examine the impulse and rescattering diagrams for πd–dπ, γd–dπ^0, and γd–dy, and use the OPE model to calculate cross sections for pd–$^4\pi$, pt–^{4}p, and ph–hp. Briefly considered are (1) backward elastic scattering from heavy nuclei (pA–Ap) and (2) inclusive nuclear reactions such as ^{14}N + A–^{6}L$_i$+ anything and pA–d+ anything. We postulate that in general nuclear reactions have Regge behavior, but are not dual, because so far there are no exotic multibaryon resonances. Nuclear reactions appear to be completely dominated by anomalous singularities, whereas ordinary nonexotic hadron reactions appear to be dominated by normal singularities and poles. (auth)

13791 CORRELATIONS BETWEEN NEUTRAL AND CHARGED PIONS IN MULTIPARTICLE PRODUCTION. Berger, E. L.; Horn, D.; Thomas, G. H. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 7: No. 5, 1412-1419 (1 Mar 1973).

We investigate the dynamical significance of correlations between $\langle n_0 \rangle_{n_-}$ and n_-, where $\langle n_0 \rangle_{n_-}$ is the mean number of neutral pions observed in conjunction with n_- negative tracks in high-energy multiparticle production processes. Several models are treated in turn. Pions are assumed to be produced either singly or in clusters, according to a Poisson or inverse-power distribution. Influences of charge, isospin, and energy-momentum conservation are studied. The linear rise of $\langle n_0 \rangle_{n_-}$ vs n_- observed experimentally at very high energies is shown to rule out some models of multiperipheral type, but is in accord with fragmentation models and with a multiperipheral model in which ρ- or ω-type meson clusters are emitted. (auth)

13792 OPTICAL MODEL FOR DIFFRACTIVE RESONANCE EXCITATION. Elitzur, M. (The Rockefeller University, New York, New York 10021); Lipes, R. G. Phys. Rev. D 7: No. 5, 1420-1425 (1 Mar 1973).

An optical model of the Chou–Yang type has been extended to treat resonance production in high-energy pp scattering. Dipole form factors have been used for the hadronic matter distribution. Good qualitative agreement with experiment is found for differential elastic and single-excitation cross sections for momentum transfers out to 2–3 GeV^2. (auth)

13793 TEST OF EXCHANGE DEGENERACY FOR PP AND P$\bar{P}$ ELASTIC SCATTERING AT HIGH ENERGIES. Greiman, William H.; Rarita, William (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. D 7: No. 3, 919-921 (1 Feb 1973).

We test the assumed exchange degeneracy of the P and ω Regge-poles for high-energy pp and $\bar{p}p$ elastic scattering. We give the results of two fits which seem to represent the data adequately. (auth)

13794 ENERGY DEPENDENCE OF THE AVERAGE CHARGED-PARTICLE MULTIPLICITY IN HADRONIC COLLISIONS. Ferbel, T. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 7: No. 3, 925-926 (1 Feb 1973).

Previous results pertaining to the growth of the pion–production cross section at 90 degrees in the center–of–mass frame are used to infer the dependence of the charged–particle multiplicity on the momentum of the projectile particle. (auth)

13795 TESTS OF HADRONIC BREMSSTRAHLUNG PRODUCTION AT LARGE NUCLEON MOMENTUM TRANSFER. Fried, H. M. (Department of Physics, Brown University, Providence, Rhode Island 02912); Gaisser, T. K. Phys. Rev. D 7: No. 3, 741-746 (1 Feb 1973).

It is suggested that hadronic bremsstrahlung may become the dominant production process in nucleon–nucleon reactions at large momentum transfer to the final nucleons. Correlation tests are proposed to distinguish the model from other models of inclusive processes. (auth)

Particle Invariance Principles and Symmetries

General

13796 HOMOGENEOUS AND NONHOMOGENEOUS GROUPS AND THEIR CLEBSCH–GORDAN COEFFICIENTS. Nowakowski, J. New York; Yeshiva Univ. (1972). 216p. University Microfilms Order No. 73-12,001.

Thesis (Ph. D.).

The analysis of irreducible unitary representations of homogeneous and nonhomogeneous groups in two-, three-, and four dimensional Euclidean and pseudoeuclidean spaces, and the computation of Clebsch–Gordan coefficients of these groups. Special attention is paid to the Poincare group which is the most important from the physical point of view. (JFP)

13797 DEFORMATION INTO MAIN AND SUPPLEMENTARY SERIES. Weimar, E. (Freie Univ., Berlin). Nuovo Cim.; No. 2, 272-283(11 Jun 1973).

It is shown that the general first-order unitary deformation of representations of inhomogeneous Lie algebras constructed previously can be realized on one and the same set of square integrable functions with the inner product being suitably defined. Thus one gets a main series for $\mu = 0$ and a supplementary series for $\mu_{min} < \mu < 0$ (if allowed). In the latter case the set has still to be completed to yield a Hilbert space. As an example the deformation $ISO_3 \rightarrow SO_{3,1}$ is studied in detail. (auth)

13798 WHAT DOES THE CENTER OF THE UNIVERSAL ENVELOPING ALGEBRA TELL US ABOUT THE DEFORMATIONS OF REPRESENTATIONS? Weimar, E. (Freie Univ., Berlin). Nuovo Cim.; 15B: No. 2, 245-256(11 Jun 1973).

It is shown that first-order deformations of representations always correspond to first-order variations of the eigenvalues of the Casimir invariants characterizing the representations. These considerations lead to a survey of first-order deformations of irreducible unitary representations of inhomogeneous Lie algebras by the aid of the method of induced representations. In this connection it is examined into how many semi-simple Lie algebras an inhomogeneous Lie algebra can be deformed. (auth)

13799 RELATIVISTIC MODEL WITH SU_6 MULTIPLET STRUCTURE. Staunton, L. P.; Van Dam, H. (Univ. of North Carolina, Chapel Hill). Lett. Nuovo Cim.; 7: No. 10, 371-374(7 Jul 1973).

A model for constructing relativistic generalizations of the nonrelativistic symmetry group SU(6) is presented, which does not appear to possess an interesting group of invariance transformations larger than the Poincare group, yet it possesses mass multiplets which are characterized by irreducible representations of SU(6). The model is an extension of a relativistic harmonic-oscillator model. (LBS)

13800 GENERAL FIRST-ORDER DEFORMATION SOLUTION. Weimar, E. (Freie Univ., Berlin). Nuovo Cim.; 15B: No. 2, 257-271(11 Jun 1973).

The general first-order deformation of representations φ of inhomogeneous Lie algebras $\mathring{L} = A \oplus B$ into those of semi-simple noncompact Lie algebras $L = A + B$ is studied. If dim $H^1(\mathring{L}, A) = 1$ and the irreducible initial representation φ with $M^2 \neq 0$ decomposes into a sum of irreducible representations of A with multiplicity 1, then the general solution can be constructed by the aid of a spectral solution of the deformation problem $\mathring{L} \to L$ and the general solution of the corresponding deformation problem $\mathring{L} \to \mathring{L}$. If B allows transitions within one representation of A the special solution is unique. Otherwise there exists an additional degree of freedom leading to — as three examples studied show — supplementary series of L. (auth)

13801 SPACE–TIME SYMMETRIES FOR A SYSTEM OF PARTICLES WITH BOTH ELECTRIC AND MAGNETIC CHARGES. Leinaas, J. M. (Univ. of Oslo). Nuovo Cim.; 15A: No. 4, 740-750(21 Jun 1973).

The invariance under Lorentz transformations of Maxwell-Lorentz' equations for a system of particles with both electric and magnetic charges is studied. For space reflection and time reversal the possibility of symmetry is examined when the charges are restricted by Dirac's quantization condition. The symmetries are shown to require that the electric charge of any monopole-carrying particle be an integer or half-integer multiple of the elementary electric charge. (auth)

13802 EIGENVALUES OF THE CASIMIR OPERATORS OF U(n) AND SU(n) FOR TOTALLY SYMMETRIC AND ANTISYMMETRIC REPRESENTATIONS. Kobayashi, K. (Saitama Univ., Urawa, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 1, 345-348(Jan 1973).

The explicit eigenvalues of the Casimir operators of U(n) and SU(n) of any order for the totally symmetric and antisymmetric representations of the most physical interest are given. This is carried out in terms of the boson and fermion operator calculus. The representations of U(n) and SU(n) are considered by the Fock space of the operators a_j. It is noted that if an $n \times n$ matrix representation of the Lie algebra of U(n)[SU(n)] is given, one can have its corresponding expression in terms of a_j and $a_j^\dagger$. (JFP)

13803 SCALE INVARIANCE, ELEMENTARY PARTICLES, AND HIGH ENERGY SCATTERING IN QUANTUM FIELD THEORY. Ginzburg, I. F. (Inst. for Mathematics, Novosibirsk, USSR). Lett. Nuovo Cim.; 7: No. 5, 155-159(2 Jun 1973).

Scale invariance of hadrons interacting at short distances is examined in a unified treatment of interactions at both short and large distances in the renormalizable quantum field theory. Deep inelastic ep scattering, pion and nucleon exchange, and multipole production are discussed. (LBS)

13804 ALL ANOMALY-FREE REPRESENTATIONS OF THE COMPACT LIE GROUPS. Saliu, L.; Tataru, L. (Univ., Craiova, Romania.). Lett. Nuovo Cim.; 7: No. 7, 253-257(16 Jun 1973).

The development of a unified theory of the weak and electromagnetic interactions based on certain gauge compact groups is considered. Anomalies in these theories have been pointed out which destroy gauge invariance of the second kind which is essentially necessary to make the theory renormalizable and unitary. All anomaly-free irreducible representations of the compact Lie algebras are presented. A possibility for modification of a theory with anomalies in such a way that the axial current coupled to massive vector boson does not have anomalous Ward identities is studied. (LBS)

13805 CAN WE DETERMINE THE MIXING ANGLE IN $SU_2 \times U_1$ GAUGE MODELS? Nanopoulos, D. V. (Univ. of Sussex, Eng.). Lett. Nuovo Cim.; 7: No. 7, 258-260(16 Jun 1973).

Previous attempts have been made to determine the mixing angle in Weinberg's $SU(3) \times U(1)$ model of weak interactions using the idea of asymptotic symmetry. It is shown that by using a general method, the mixing angle can be determined in a general class of $SU(2) \times U(1)$ models, provided that the Schwinger term is a c-number. (LBS)

13806 ANOMALIES FOR ANY LIE GROUP. Marculescu, S. (Univ., Karlsruhe, Ger.). Nuovo Cim.; 16A: No. 1, 69-84(1 Jul 1973).

Anomalies in Ward identities for arbitrary Lie groups are investigated. In general two types of anomalies are found: one of them is that calculated by Bardeen in spinor theory and the other one consists of functions of the gauge field covariant curl alone. The semi-simple compact Lie groups do not possess the latter type. In particular, for $G \otimes G$ groups it is always possible to have Ward identities without vector anomalies and for the axial anomaly one recovers again the spinor-theory result. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 14086 and 14149.

13807 SELECTION RULE OF WEAK PROCESSES AND DECAYS OF NEW PARTICLES. Hayashi, T. (Hiroshima Univ.); Nakagawa, M.; Nitto, H.; Ogawa, S. Progr. Theor. Phys. (Kyoto); 49: No. 1, 350-352(Jan 1973).

A selection rule for weak processes $\Delta n_t = 0$ in the actual decay process is proposed. Decay processes of new particles recently suggested in the cosmic ray jet are used. The results of the selection rule for the decays of mesons and baryons in the lowest multiplets of U(4) symmetry for super hadrons with nonzero N′ are summarized. (JFP)

13808 $SU(2) \times U(1)$ GAUGE THEORIES OF THE GENERALIZED SIGMA MODEL FOR $\pi^0, \eta, \eta' \to \gamma\gamma$ DECAYS. Yu, L. P. (Univ. of California, San Diego, La Jolla). Nucl. Phys.; B57: No. 2, 629-636(1973).

By embedding the chiral current-mixing gauge theories in the $SU(2)_L \otimes SU(2)_R$ generalized σ model, it is shown that the correct sign and magnitude for $\pi^0 \to \gamma\gamma$ decay, as well as the SU(3) relation of $\pi^0, \eta, \eta' \to \gamma\gamma$ decays can be obtained within the framework of $SU(2) \otimes U(1)$ gauge theories of weak and electromagnetic interactions. (auth)

13809 CP-VIOLATION IN THE RENORMALIZABLE THEORY OF WEAK INTERACTION. Kobayashi, M.; Maskawa, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 652-657(Feb 1973).

In a framework of the renormalizable theory of weak interaction, problems of CP-violation are studied. It is concluded that no realistic models of CP-violation exist in the quartet scheme without introducing any other new fields. Some possible models of CP-violation are also discussed. (auth)

13810 REMARKS ABOUT SCALING BEHAVIOR IN THE PARTON MODEL. Kim, B. R.; Rodenberg, R. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 7: No. 7, 261-263(16 Jun 1973).

The process $e + p \to e +$ anything was previously considered whereby an expression was obtained for the limiting behavior of the tensor $W_{\mu\nu}$ in the limit $p \to \infty$ (p = energy of the nucleon). It was concluded that the dominant terms in $W_{\mu\nu}$ for $p \to \infty$ give only information about W_2 and not about W_1. It is commented that the argument is not generally valid in the Bjorken region; that in the Bjorken region also $-q^2$ and ν tend to infinity with $-q^2/\nu$ fixed. It is shown that the term p^2/ν can be of the order of 0(1). (LBS)

13811 CHARGE ASYMMETRY IN $K_L^0 \to \pi\mu\nu$. Piccioni, R. L. Stanford, CA; Stanford Univ. (1972). 84p. University Microfilms Order No. 73-15,011.

Thesis (Ph. D.).

For $\Gamma_+ \equiv$ rate $(K_L^0 \to \pi^+\mu^+\nu)$, the charge asymmetry, $\delta \equiv (\Gamma_+ - \Gamma_-)/(\Gamma_+ + \Gamma_-)$ was measured to be $(+0.28 \pm 0.05)\%$. Such an asymmetry is evidence of CP violation. The result was compared with previous CP violation experiments in this and other decay modes of the neutral kaon. Consistency was found among

the experiments, and consistency was found with the predictions of the superweak theory. (Diss. Abstr. Int., B)

Applications (Strong)

13812 (JINR-P2-7187) STATISTICAL THEORY OF INELASTIC PROCESSES WITH SU_6-MULTIPLETS. Barashenkov, V. S.; Beshtoev, Kh. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

SU_3-symmetrical statistical Fermi theory is considered under the condition that particles in the final state are the members of SU_6 multiplets. Such an approach allows one to decrease considerably the number of different reaction channels which must be taken into account in calculations what essentially simplifies them and they can be extended to the region of the order of several dozens and even hundreds of GeV. By the example of $\bar{N}-N$ annihilation the theory is compared with experiment. The possibility of more wide use of SU_6-symmetry in calculations of multiple particle production is discussed. (auth)

13813 SYMMETRY BREAKING OF CHIRAL U(3) U(3) AND $X \rightarrow \eta\pi\pi$ DECAY AMPLITUDE. Kobayashi, M. (Kyoto Univ.); Kondo, H.; Maskawa, T. Progr. Theor. Phys. (Kyoto); 49: No. 2, 634-639(Feb 1973).

The singlet-octet mixing of ps-mesons is discussed based on chiral U(3) ⊗ U(3) symmetry under the assumption that the breaking of chiral SU(3) ⊗ SU(3) symmetry belongs to a $(3,3^*) \oplus (3^*,3)$ representation. The width of $X \rightarrow \eta\pi\pi$ decay is calculated for two models on the breaking of U(3) ⊗ U(3) by using the observed momentum dependence. It is also pointed out that the momentum dependence of the amplitude disappears in the symmetry limit of SU(3) up to second order in the momentum. (auth)

13814 COULD SU_3 BE AN EXACT REDUCED-VERTEX SYMMETRY? Rotelli, P. (International Centre for Theoretical Physics, Trieste, Italy); Scadron, M. D. Nuovo Cim.; 15A: No. 4, 648-662(21 Jun 1973).

SU_3 predictions for the most reliable data on resonance decays are investigated for both linear and quadratic meson mixing. Contrary to prevalent opinion, no convincing evidence of SU_3 violation is found although an essential redefinition of the reduced matrix element for decuplet decays is required. (auth)

13815 SYMMETRY BREAKING AND $\eta' \rightarrow \eta\pi\pi$ DECAY. Brown, Lowell S. (Physics Department, University of Washington, Seattle, Washington 98195); Harun-ar-Rashid, A. M. Phys. Rev. D 7: No. 3, 913-917 (1 Feb 1973).

A broken-chiral- and -dilational-invariant effective Lagrangian with a symmetry-breaking term belonging to the $(3,3^*) \oplus (3^*,3)$ representation of SU(3) ⊗ SU(3) is used to obtain the matrix element of the σ term between η and η'. It utilizes both wave-function-renormalization mixing and mass-matrix mixing. The presently available upper limit of the $\eta' - \eta\pi\pi$ decay rate requires a rather large value for this σ term and, correspondingly, rather large values for the mixing parameters that vanish in the symmetry limit and ought to be small. (auth)

13816 U_3 SYMMETRY BETWEEN BARYONS AND MESONS. Bella, G. (Tel Aviv Univ., Israel). Nuovo Cim.; 16A: No. 1, 143-152(1 Jul 1973).

The group $U_{3|}$, where the spin and baryonic number replace the isospin and hypercharge respectively, is discussed. The spin-changing currents are constructed in terms of a fermion field which is a Goldstone field arising from the nonlinearity of the transformation laws. All the other fields are considered as being formed from this fundamental field. For a relatively simple model, irreducible representations containing together mesons and baryons, and corresponding mass formulae are obtained. (auth)

13817 APPROXIMATE SCALE INVARIANCE AND BROKEN-SU_3 COUPLING CONSTANTS. Eliezer, S. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 16A: No. 1, 124-134 (1 Jul 1973).

Under the assumption that the matrix elements of the divergences of the dilation current ($\partial^\mu D_\mu = \Theta^\mu_\mu$) are dominated by two poles, it is shown that the present experimental data for the dilaton (ϵ) are consistent with an unsubtracted dispersion relation of $\Gamma(q^2) \equiv \langle P|\Theta^\mu_\mu|P\rangle$ ($= \pi$, K or η), a significant SU_3 violation in ϵPP couplings and no apparent singlet-octet mixing for the scalar mesons. As far as the slope $\Gamma' \equiv \Gamma/dq^2|_{q^2=0}$ is concerned, in the SU_3 symmetry limit $\Gamma' \simeq 1$, while SU_3-symmetry-breaking effects change this value to $\Gamma' \simeq 0.5$ in consistency with a general theorem given by Okubo. By demanding maximal smoothness it is found that the scale dimension of the scalar densities (which break chiral $SU_3 \times SU_3$ as well as scale symmetries in the energy density) is $d_u = 1$. However, the general relation between the dilaton mass (m_ϵ) and the dimension d_u (eq. (31)) gives $m_\epsilon \simeq 700$ MeV, 600 MeV and 400 MeV for $d_u = 1$, 2 and 3 respectively. (auth)

13818 SPIN AND ISOSPIN IN PARTICLE PHYSICS. Carruthers, P. A. New York; Gordon and Breach, Science Publishers, Inc. (1971). 265p. $19.50.

Theoretical methods useful for the description of the spin and isospin coordinates of elementary particles are reviewed. The representations of the Lorentz and Poincare groups are studied and related to various kinds of wave functions for particles of arbitrary spin. An extensive discussion of the discrete symmetry transformations of charge conjugation and space and time inversions is given for fields carrying internal symmetries. Applications are made to typical strong interaction problems. (LBS)

Scattering Theory

13819 (JINR-P2-6867, pp 215-245) QUASI-POTENTIAL MODEL EQUATIONS FOR RELATIVISTIC THREE-BODY SYSTEMS. Kvinikhidze, A. N.; Stoyanov, D. Ts. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

13820 ANALYTIC PROPERTIES OF THE IMPACT PARAMETER AMPLITUDE. Obara, T. (Nihon Univ., Mishima, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 2, 586-593(Feb 1973).

Analytic properties of the impact parameter amplitude H(s,b) are discussed in the b-plane. It is shown that H(s,b) has algebraic branch points at b = 0 and their orders depend on the Regge trajectory, if the amplitude is expressed by the Regge pole. As an example a detailed discussion is given for the Veneziano amplitude. It is also stressed that the s-plane analyticity of H(s,b) is much simpler than that of the partial wave amplitude. (auth)

13821 PROPERTIES OF THE IMPACT-PARAMETER REPRESENTATION. Kupsch, J. (Univ., Heidelberg); Stamatescu, I. O. Nuovo Cim.; 15A: No. 4, 663-688(21 Jun 1973).

The impact-parameter representation is discussed in the approach of Blankenbecler and Goldberger. After generalizing the Bessel transform to distributions (this allows power-behaved amplitudes to be considered), the results of Henzi about the analytic properties of the impact-parameter function h(s,b) are extended. In particular it is shown that the amplitude F(s,t) satisfies dispersion relations in t with a finite number of subtractions if and only if h(s,b) is generated by an analytic function $H(s,b^2)$ which fulfils similar dispersion relations in b^2. These results are further applied to investigate the implications of simple elements of the analytic structure of h(s,b), as poles and cuts. The corresponding behavior of F(s,t) is examined in the asymptotic t-region and also for small |t| and the consequences for the partial waves are described. (auth)

13822 CONSTRUCTION OF DEFINITE-PARITY AMPLITUDES FREE OF KINEMATICAL SINGULARITIES FOR TWO-PARTICLE REACTIONS OF ANY SPIN. Langbein, W. (Max-Planck-Institut fuer Physik and Astrophysik, Munich). Nuovo Cim.; 15A: No. 4, 785-809(21 Jun 1973).

The approaches to decompose scattering amplitudes with four massive nonzero-spin particles are discussed and the construction of definite-parity amplitudes free of kinematical singularities are simplified by relating them to the amplitudes of the Joos decomposition by a gaugelike transformation. The method is applied to both arbitrary-spin boson and fermion reactions. (auth)

13823 BEHAVIOR OF THE RENORMALIZED FEYNMAN AMPLITUDES UNDER SCALE TRANSFORMATIONS. Kovalenko, V. F. (Inst. of Theoretical Physics, Kiev). Teor. Mat. Fiz.; 15: No. 3, 340-352(Jun 1973). (In Russian).

The behavior of analytically renormalized Feynman amplitudes under scale transformations in scalar field theory with $\lambda\varphi^4(x)$ interaction and $m^2 \neq 0$. It is shown that under the scale transformations of the renormalized Feynman amplitudes, the logarithmic terms arise as a result of the regularization. (auth)

13824 TRIVIALITY CONDITIONS FOR THE S-OPERATOR IN THE HAAG-RUELLE SCATTERING THEORY. Koshmanenko, V. D. (Inst. of Mathematics, Kiev). Teor. Mat. Fiz.; 15: No. 3, 297-306(Jun 1973). (In Russian).

In the framework of Hepp's formulation of the Haag-Ruelle scattering theory a number of conditions, under which the asymptotical ingoing and outgoing fields coincide with each other, is found. In particular, the theory is proved to be trivial, if there exists an invertible operator connecting the states of the interpolating field with those of one of asymptotical fields. The boundedness of the operator is not required. (auth)

13825 MULTIPLE COMPLEX ENERGY S-MATRIX POLES IN CONTINUUM SHELL-MODEL CALCULATIONS. Romo, W. J. (Carleton Univ., Ottawa). Nucl. Phys.; A209: No. 2, 396-418 (1973).

A study is made of the analytic properties of partial-wave S-matrix elements arising from continuum shell-model calculations with particular emphasis placed on Nth order poles of the S matrix with $N \geq 2$. The dependence of these poles upon the potential parameters and their physical consequences are also investigated. (7 figures) (auth)

13826 POSSIBLE CLASSICAL ANALOGY OF THE CONCEPT OF RESONANCE IN ELEMENTARY PARTICLE PHYSICS. Bednar, M. (Fysikalni Ustav, Prague). Cesk. Cas. Fys.; 23A: No. 3, 272-279(1973). (In Czech).

The classical analogy of quantum-mechanical resonance scattering is discussed. The connection between the quantum-mechanical and the classical resonance scattering of two particles without internal structure is demonstrated by help of simple solvable models on the basis of characteristic time delay which takes place in such scattering. (auth)

13827 RELATIVISTIC EIKONAL APPROXIMATION FOR A THREE-BODY SCATTERING AMPLITUDE. Balakrishnan, B. (Punjab Univ., Chandigarh, India). Lett. Nuovo Cim.; 7: No. 7, 250-252(16 Jun 1973).

The eikonal technique is applied to the three-body generalized ladder graphs. A comparison is made of eikonal, variational, and experimental values for the ground-state energy levels of some two-electron atoms. It is concluded that although the eikonal technique is able to sum the generalized ladder graphs for the three-body amplitude, it does not succeed as well as in the two-body case in predicting the bound-state energy levels. (LBS)

13828 NEW PROOF OF KATO'S LEMMA ON SCHWINGER'S VARIATIONAL PRINCIPLE FOR SCATTERING PHASE. Sharma, C. S. (London Univ.); Rebelo, I. Phys. Lett.; 44A: No. 1, 29-30 (7 May 1973).

An elegant, modern and rigorous proof of Kato's lemma for Schwinger's variational principle for scattering phase is given. (auth)

13829 BOUNDS ON POMERANCHUKON AMPLITUDES AND THE POSITIONS OF THEIR ZEROS. Avni, Yoram; Savit, Robert (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 7: No. 3, 856-864 (1 Feb 1973).

Rigorous lower bounds on the imaginary part of helicity-nonflip elastic amplitudes are derived under the assumption that their impact-parameter representations are monotonically decreasing functions of b (central profiles). One result of these bounds is that at intermediate to high energies, typical Pomeranchukon-dominated elastic helicity-nonflip amplitudes must not have zeros for $|t| \lesssim 0.6$ BeV^2. A connection between the phenomenological absence of zeros in these Pomeranchukon amplitudes at small $|t|$ and the conjectured central behavior of the profile is thus established. (auth)

13830 TWO-BODY SCATTERING WITH SINGULAR POTENTIALS. Bishop, R. F. (Institute of Theoretical Physics, Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. C 7: No. 2, 479-488 (Feb 1973).

The two-body scattering formalism is developed in a manner that makes it clear where the assumption of a "smooth" potential enters. Particular attention is paid to the modifications necessary if the scattering states do not form a complete set, as is the case for the pure hard-core (HC) potential and the pure (i.e., no external potential) boundary-condition model (BCM). As examples, the fully-off-shell t matrices for HC and BCM are developed without treating them as the limits of finite-potential models. A general expression is derived for the fully-off-shell t matrix, which can be applied to the general HC or BMC with external potential, and which involves only the solution to the Schrödinger equation in the external potential. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

13831 VORTEX-RING MODEL OF BOSE CONDENSATION. Wiegel, F. W. (Univ., Amsterdam). Physica; 65: No. 2, 321-336(15 Apr 1973).

The partition function of the interacting Bose fluid is represented by an integral over function space and is evaluated approximately by an extension of the saddle-point method. In this way a vortex-ring model is derived from first principles. The superfluid phase of the Bose fluid is represented by a uniform field with a small number of quantized vortex rings of small circumference. In the normal phase the field is in a state of stationary homogeneous turbulence on a microscopic scale. The model leads to a combinatorial problem which, when solved approximately, gives a specific-heat exponent $\alpha = \frac{1}{3}$. The analogy with the droplet model of condensation is discussed. (auth)

13832 QUANTUM HYDRODYNAMICS OF A BOSE FLUID. II. Biswas, A. C.; Rama Rao, I. (Tata Inst. of Fundamental Research, Bombay). Physica; 65: No. 2, 412-420(15 Apr 1973).

The Landau-Khalatnikov two-fluid hydrodynamic equations for a superfluid Bose system, derived using action-angle variables in quantum statistics. (auth)

13833 THEORETICAL ANALYSIS OF LIGHT SCATTERING FROM SUPERFLUID HELIUM CLOSE TO THE λ PHASE TRANSITION. Kretzen, H. H.; Mikeska, H. J. (Technische Univ., Hanover). Physics Letters; 43A: No. 6, 525-526(23 Apr 1973).

The contribution from order parameter fluctuations to the light scattering cross section in ^{4}He near T_λ is calculated including effects from order parameter relaxation. The existence of a central dip in the critical region is discussed. (auth)

13834 ROTON-ROTON INTERACTIONS IN SUPERFLUID HELIUM. II. Nagai, K. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 46-62(Jan 1973).

For the purpose of studying the roton-roton interaction in superfluid helium, the temperature variation of the self energy of the roton is calculated by use of the self-consistent T-matrix approximation. The results are compared with the date of the inelastic neutron scattering experiments. The structure of the T-matrix is determined by the coupling constant and the single roton energy width. The major contribution to the self energy comes from the scattering channels with attractive coupling. For a strong attractive coupling, two-roton resonance states occur and the self energy shows an anomalous temperature dependence far from the experiments. Therefore, attractive coupling constants are required to be weak in order to reproduce the simple nature of the temperature variation of the observed energy shift. A comment is given on the two-roton spectra of the inelastic neutron scattering. (auth)

13835 TEMPERATURE DEPENDENCE OF PHONON VELOCITY AND ROTON MINIMUM IN LIQUID He II. Kebukawa, T. (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 388-400 (Feb 1973).

The temperature dependence of phonon velocity and roton minimum is investigated from the microscopic point of view, by taking into account the contributions from the interactions between quasi-particles given previously. In consequence, it is found that the phonon-roton interactions and the roton-roton interactions play very important roles in the temperature dependence of phonon velocity and roton minimum, respectively. The results are compared with experiments to yield fairly good agreement. (auth)

13836 SUPERFLUIDITY OF THE FERMI COMPONENT IN A FERMI-BOSE GAS AND IN ^{3}He-^{4}He SOLUTIONS. Andrianov, V. A.; Popov, V. N. (Inst. of Mathematics, Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1861-1864(May 1973). (In Russian).

The possibility of superfluidity of the Fermi component of a Fermi-Bose gas is demonstrated for a model in which a pure Fermi system is not superfluid even at T = 0. Extrapolation of the formulas derived to ^{3}He-^{4}He solutions yields an estimate of the upper limit of the transition temperature of the Fermi component to the superfluid state, viz. 10^{-3}-10^{-4}°K. (auth)

13837 MEASUREMENT OF THE RELAXATION TIME ON ACCELERATION OF VESSELS WITH HELIUM II AND THE SUPERFLUIDITY IN PULSARS. Tsakadze, J. S.; Tsakazde, S. J. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1816-1823(May 1973). (In Russian).

The behavior of superfluid helium on variation of the rotation velocity of vessels of various geometry is investigated experimentally. In this way an attempt is made to simulate relaxation processes accompanying sudden acceleration of the solid shell of a pulsar. (auth)

13838 CRITICAL VELOCITIES FOR VORTEX FORMATION BY AN OSCILLATING DISC IN HELIUM II AND RELAXATION PROCESSES DURING ITS ROTATION. Nadirashvili, Z. Sh.; Tsakazde, J. S. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1672-1678(May 1973). (In Russian)

The critical velocity for vortex formation in rotating helium II as depending on its temperature is investigated by the oscillating disc technique. It is shown that in a state of rotation the critical velocity for vortex formation is greater than in a state of rest. Relaxation processes occurring in helium II due to its sudden rotation or to variation of its rotation velocity or to cooling of rotating helium I below T_λ are studied by the same method. (auth)

13839 FLOW OF SUPERFLUID HELIUM THROUGH SMALL ORIFICES. Banton, M. E. New Haven; Yale Univ. (1972). 123p. University Microfilms Order No. 73-14,234.

Thesis (Ph. D.).

The flow of superfluid helium through orifices of diameters 2.5, 5, and 7.5 microns has been investigated for the temperature range 0.4 to 1.25°K. Temperatures below 1.25°K were produced by a ^{3}He refrigerator designed and built for this work. Work at 1.25°K with a 2.5 micron diameter orifice demonstrated that spontaneous jumps in the velocity of the superfluid occur in flow through orifices. There was evidence that in some cases the jumps were quantized in ratios of small integers. Data taken at 1.25°K with a 5 micron diameter orifice exhibited "intrinsic" behavior. By "intrinsic" flow is meant flow in which the velocity limiting process is produced by thermal fluctuations. Notarys' measurements on flow through porous mica (800 Å diameter pores) produced a value of 1.1×10^{-12} c.g.s. for the constant β which appears in his extension of the thermal activation theory to pressure-driven superflow. Measurements on our 50,000 Å channel gave a value for β of 0.89×10^{-12} c.g.s. This indicates that some phenomenon other than the smallness of the channel is responsible for the lack of agreement between the experimental and theoretical (50×10^{-12} c.g.s.) values of β. No intrinsic behavior was seen at 0.4 or 0.48°K. Also no intrinsic behavior was seen for a 7.5 micron orifice. Work with a 2.5 micron diameter orifice produced flow data which exhibited velocities comparable to those observed in the intrinsic flows. However, it is shown that these flows are not intrinsic in character. This points out the uncertainty in identifying a flow as intrinsic on the basis of its having a large velocity. Other data taken on the 5 micron diameter orifice exhibited a low velocity mode of flow which was independent of temperature and in which the velocity was dependent on the driving pressure. The data on this low velocity mode is superior in resolution to any other and represents the first observation that the mode is independent of temperature. In flow data taken on a 2.5 micron diameter orifice we observed that velocity jumps were more likely to occur at certain pressure heads. It is speculated that this observation may be a consequence of the ac Josephson effect in superfluid helium. (Diss. Abstr. Int., B)

Superconductivity

Refer also to abstracts 13116, 13307, and 13311.

13840 ANOMALOUS HEAT CAPACITY OF SUPERCONDUCTING NIOBIUM. Sellers, G. J. (Univ. of Illinois, Urbana); Anderson, A. C.; Birnbaum, H. K. Phys. Lett.; 44A: No. 3, 173-174(4 Jun 1973).

No evidence is found in the specific heat of niobium which would be indicative of a second superconducting energy gap in this transition metal. The specific heat anomaly previously associated with a second gap is shown to be caused by hydrogen impurity. Substitution of deuterium for hydrogen produces a significant change in the temperature dependence of the anomaly. (auth)

13841 METHOD FOR INVESTIGATING ELECTRONIC STATE DENSITIES FOR SUPERCONDUCTORS WITH IMPURITIES. Moskalenko, V. A.; Ursu, A. M.; Botoshan, N. I. (Moldavian Academy of Sciences, USSR). Phys. Lett.; 44A: No. 3, 183-184 (4 Jun 1973).

A method for investigation of the densities of the electronic states for a one-band superconductor with small concentration of paramagnetic impurity and of a two-band superconductor with nonmagnetic impurity is developed. (auth)

13842 MAGNETIC FIELD DISTRIBUTION IN TYPE-II SUPERCONDUCTORS WITH SMALL MAGNETIZATION. Brandt, E. H. (Institut fuer Physik Stutgart, Ger). Physics Letters; 43A: No. 6, 539-540(23 Apr 1973).

The magnetic field of type-II superconductors with small magnetization is calculated by minimizing the free energy. At low temperatures the strange field distribution obtained by Delrieu is confirmed. (auth)

13843 FLUX-LINE LATTICES OF PURE TYPE II SUPERCONDUCTOR WITH ANISOTROPIC FERMI SURFACE ($T \sim 0$). Takanaka, K. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 49: No. 1, 64-75(Jan 1973).

The free energy appropriate for a pure single crystal type II superconductor with an anisotropic Fermi surface is calculated near the upper critical field H_{c2} at low temperatures. It is shown that various flux-line lattices can occur depending on the magnitude of the anisotropy and the direction of the applied magnetic field relative to the crystal axis. (auth)

13844 CHARACTERISTIC OF THE ELECTRIC FIELD IN THE RESISTIVE STATE OF TYPE-II SUPERCONDUCTOR. Sikora, A.; Makiej, B.; Trojnar, E.; Jaszcuk, W. (Inst. of Low Temperature and Structure Research, Wroclaw). Acta Phys. Pol.; A43: No. 6, 781-785(1973).

It was established that in a sample of type-II superconductor in the resistive state the transversal voltage occurs when the current flows along the sample axis. The dependence of the transversal voltage on current and the position of the contacts were estimated. It is assumed that the occurrence of the transversal voltage is caused by the motion of the magnetic flux quanta in the sample. (auth)

13845 RENORMALIZATION GROUP THEORY FOR A ONE-DIMENSIONAL FERMI SYSTEM. Kimura, M. (Kanazawa Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 2, 697-698(Feb. 1973).

In order to clarify Little's mechanism of a superconducting molecular chain, the temperature behavior of the simplified model of a one-dimensional Fermi system with interaction $\Gamma^0_{\alpha_1\alpha_2\alpha_3\alpha_4} = g(\delta_{\alpha_1\alpha_2}\delta_{\alpha_2\alpha_4} - \delta_{\alpha_1\alpha_4}\delta_{\alpha_2\alpha_3})$ is investigated. An attempt is made to improve the perturbational approach toward the asymptotic behavior of the scattering amplitudes. (JFP)

13846 PROCEEDINGS OF THE 1972 APPLIED SUPERCONDUCTIVITY CONFERENCE. Conference Held at Annapolis, Maryland, May 1–3, 1972. IEEE Pub. No. 72CH0682-5-TABSC. New York; Institute of Electrical and Electronics Engineers, Inc. (1972). 747 p. (CONF-720513--). $20.00.

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972).

One hundred eleven papers are included. Separate abstracts were prepared for 100. For abstracts of the remaining papers refer to CONF-720513 in a cumulative report number index. (MHR)

For abstracts of individual papers see: 13847–13867, and 13890–13968.

13847 V_3Ga AND OTHER HIGH-FIELD SUPERCONDUCTORS BEING DEVELOPED IN JAPAN. Tachikawa, K. (National Research Inst. for Metals, Tokyo). pp 371-376 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

Processing and properties of V_3Ga and other superconducting compounds being developed in Japan are described. Superconducting V_3Ga tapes produced by a surface diffusion process seem to be capable of generating fields as high as 180 kOe. Multifilamentary V_3Ga wires made by a composite process seem to be useful for ac applications. Other A-15 type crystal structure materials, e.g., $(Nb,Zr)_3Sn$ made by diffusion process and ternary compounds based on Nb_3Al have also been investigated. Upper critical fields exceeding 250 kOe have been obtained at 4.2 K, both in NbN films made by a reactive sputtering and in ternary Laves phase compounds based on V_2Hf. (auth)

13848 NIOBIUM–TIN TECHNOLOGY. Rosner, C. H. (Intermagnetics General Corp., Guilderland, NY). pp 377-384 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Nb_3Sn, the first superconductor discovered to have high magnetic field properties and magnet potential, has undergone considerable study and development during the past decade. Conductors produced on the basis of various processing approaches and data on present day characteristics are presented in terms of current density, technological utility and applications made possible by the increasing availability of 150 kG Nb_3Sn magnets. Further conductor developments towards obtaining increased stability and mechanical strength as well as suitability for devices involving both dc and varying fields are discussed, including high purity aluminum clad tapes as well as multifilamentary Nb_3Sn superconductors. (auth)

13849 FILAMENTARY COMPOSITE SUPERCONDUCTORS FOR PULSED MAGNETS. Wilson, M. N. (Rutherford Lab., Didcot, Eng.). pp 385-394 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Composites containing up to 9000 filaments of niobium titanium are now being tested for use in pulsed magnets. It would be advantageous to go to still higher numbers but this would increase the coupling between filaments and therefore increase losses and decrease stability. The paper tries to see how this coupling will limit N, the number of filaments which can usefully be put into a composite. Magnetization and self field effects are treated separately. A new theory of magnetization in three component composites is presented and its implications for N are discussed. Self field theory is extended and two new mechanisms are suggested which could, in practice, reduce the magnitude of the self field effect. It is concluded that 20,000 filaments are now possible and that N could eventually be pushed as high as 10^5. (auth)

13850 PROPERTIES OF SUPERCONDUCTING Nb_3Ga MATERIALS. Foner, S.; McNiff, E. J. Jr. (Massachusetts Inst. of Tech., Cambridge). pp 404-407 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The upper critical field, H_{c2}, versus temperature, T, was measured in a series of Nb_xGa_{1-x} materials. When properly fabricated the stoichiometric material, Nb_3Ga, yields $T_c = 20.3$ K—the highest yet reported for a binary alloy. Measurements of $H_{c2}(T)$ with dc fields (to 210 kG) and pulsed fields show: (1) a closely linear variation of $H_{c2}(T)$ versus T near T_c, (2) $(dH_{c2}/dT)_{T=T_c}$ varies from ~20 to 25 kG/K, and (3) the $H_{c2}(T)$ data show no appreciable evidence of Pauli paramagnetic limiting. Values of $H_{c2}(4.2\text{ K})$ vary from 340 kG to 135 kG for materials with T_c = 20.0 K and 13.3 K respectively. Preliminary work shows that Nb–Ga materials with $T_c \simeq 19$ K can be made by chemical vapor deposition (CVD), a process commonly used for producing commercial superconducting tape. Preliminary measurements in ~15μ thick (CVD) Nb–Ga samples yield critical currents comparable to those of Nb_3Sn (CVD) tape for fields <170 kG. (auth)

13851 SYNTHESIS OF A15 Nb–Ga COMPOUNDS HAVING HIGH T_c's. Deis, D. W.; Blaugher, R. D.; Hulm, J. K.; Gavaler, J. R. (Westinghouse Research Labs., Pittsburgh). pp 407-410 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The superconducting transition temperatures of Nb–Ga alloys with Ga contents between 20 and 37.5 atomic percent were studied as a function of heat treatment. This work indicates that Nb–Ga material with transitions close to 20°K can only be obtained by rapid cooling or quenching from high temperatures in the vicinity of 1800°C followed by low temperature annealing around 700°C. The increase in T_c observed after annealing at 700°C is suggestive of a mechanism involving the degree of long range atomic ordering. (auth)

13852 CRITICAL CURRENTS IN GRANULAR SUPERCONDUCTORS. Watson, J. H. P. (Corning Glass Works, NY). pp 411-414 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Measurements are described of the critical current density J_c for superconducting lead, indium, and lead bismuth alloys in porous glass as a function of temperature and magnetic field. The results are interpreted in terms of a simple model. (auth)

13853 UPPER CRITICAL FIELDS OF SUPERCONDUCTING LAVES PHASES IN V–Hf–X TERNARY ALLOYS. Inoue, K.;

Tachikawa, K. (National Research Inst. for Metals, Tokyo). pp 415-418 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Pronounced improvements in upper critical field, H_{C2}, have been achieved by the addition of zirconium, niobium, tantalum, and chromium to V_2Hf, C-15 type crystal structure Laves phase in V-Hf alloys. The highest H_{C2}(4.2 K) obtained in V-Hf-Zr, V-Hf-Nb, V-Hf-Ta, and V-Hf-Cr ternary alloys are 240 kOe, 257 kOe, 261 kOe, and 234 kOe, respectively. Large electronic specific heat coefficient, normal state resistivity, and spin-orbit-scattering effect due to heavy hafnium atoms, seem to cause high H_{C2} in this type of material. A sign of low temperature lattice instability, like the case of β-W type compound, is observed in the temperature dependence of the electrical resistivity, magnetic susceptibility, and lattice parameter of these Laves phase compounds. (auth)

13854 SUPERCONDUCTIVITY IN THIN FILMS ON THE Mo-Re SYSTEM. Gavaler, J. R.; Janocko, M. A.; Hulm, J. K.; Jones, C. K. (Westinghouse Research Labs., Pittsburgh). pp 419-421 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A series of Mo-Re alloy films was prepared by sputtering from a composite molybdenum and rhenium cathode. These films were deposited in an ultra-high purity environment onto sapphire substrates which were held at temperatures ranging from 400°C to 1300°C. Maximum transition temperatures observed were ~15 K which is significantly greater than the highest reported bulk values. Critical current and field characteristics also were found to be considerably greater in the films compared to corresponding bulk samples. Upper critical fields of over 100 kOe were measured in the highest T_c films—more than a factor of four higher than the maximum values reported for the bulk. These enhanced properties are discussed in relation to the structural characteristics of the sputtered films. (auth)

13855 MAGNETO-OPTICAL STUDIES OF SUPERCONDUCTORS AT HIGH TRANSPORT CURRENT DENSITIES. Huebner, R. P.; Kampwirth, R. T. (Argonne National Lab., IL). pp 422-424 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The current-induced magnetic flux structure was investigated in microstrips of superconducting lead and indium with a thickness between 4 and 8 μm using a high-resolution magneto-optical method. The applied electrical transport current had an average density between 10^5 and 10^6 A/cm^2. The current-induced magnetic structure consists of narrow "channels" of normal material which grow abruptly from both edges to the center of the strip. The number of these normal channels increases with the transport current. The magnetic field in these channels has, of course, opposite sign for the two sides of the strip. The abrupt growth of each normal channel from the edge to the center of the strip is associated with a magnetic instability similar to the kink instability in magnetohydrodynamics. Simultaneously with the appearance of the first normal channels, resistive voltages are detected in the specimens. (auth)

13856 DEPENDENCE OF J_c OF ANNEALED Nb-Zr ON AMOUNT OF DEFORMATION INTRODUCED PRIOR TO ANNEALING. Milne, I. (Central Electricity Labs., Leatherhead, Eng.); Finlayson, T. R. (pp 425-428 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Critical current densities (J_c) in Nb-26%Zr and Nb-32%Zr were studied as a function of deformation by rolling both before and after annealing the material. Unannealed, the J_c increased with deformation. After annealing the maximum J_c obtained stabilized after 80% reduction in area, when the flux pinning constituent was β_{Zr} precipitate. The volume fraction of β_{Zr} increased with Zr content and with deformation. The J_c's obtained in these alloys were much lower than were obtained previously in Nb-25%Zr drawn wire and Nb-40%Zr rolled foil. In the Nb-25%Zr because of the good purity of this material precipitation was on too small a scale to prevent polygonization of the dislocation substructure, unlike in the alloys studied here. This polygonized structure was more efficient at pinning flux than the precipitation structure of the Nb-26%Zr or the Nb-32%Zr. In the Nb-40%Zr, however, a larger volume fraction of precipitate was available for flux pinning than in either of the alloys studied here and this produced material with a higher J_c. (auth)

13857 RELATIONSHIP BETWEEN DEFECT STRUCTURE, FLUX-LINE LATTICE, AND METALLURGICAL TREATMENT IN HIGHFIELD SUPERCONDUCTOR NbTi. Hillmann, H.; Hauck, D. (Vacuumschmelze GmbH, Hanau, Ger.). pp 429-433 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Composites of Nb-50 weight % Ti alloys showing high density α-precipitates by alternating cold work and heat treatment have been further cold worked. The following results were found by measurements of the critical current density and critical Lorentz force: Current density increases with increasing cold work, exceeding a maximum value and decreasing by further cold work. For different external fields the maxima of j_c(d) (d..... composite diameter) corresponds to different degree of cold work. The pinning force shows also a maximum shifting to higher inductions B for stronger coldwork and corresponding to a decreasing slope of the j_c(B) curve. By these results a model is given for the relationship of metal physical process effected by metallurgical treatment on the one hand and physical properties on the other. Under special conditions the occurrence of relative peaks corresponding to a matching between flux line lattice and pinning site distribution could be demonstrated. (auth)

13858 CHANGE IN CRITICAL CURRENT OF SUPERCONDUCTING NbTi BY NEUTRON IRRADIATION. Soell, M. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.); Wipf, S. L.; Vogl, G. pp 434-439 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Nb-50 wt.% Ti (Nb-66 at.% Ti) wires 11 and 21 μ in diameter were exposed at 5°K to neutron irradiation (E > 0.1 MeV) in the Munich research reactor at Garching. The critical currents as a function of a transverse magnetic field, measured immediately afterwards, showed for all wires a reduction from the original values. Subsequent five-minute annealing at different temperatures brought an improvement in the critical current each time. In some cases the original values were recovered. (auth)

13859 EXPERIMENTAL TEST OF THE EFFECT OF PRECIPITATE PINNING ON MIXED STATE RF LOSS AND DEPINNING FREQUENCY OF TYPE II SUPERCONDUCTORS. Weinman, L. S. (Naval Research Labs., Washington, DC); Lewis, J. B. III; Rose, R. M. pp 440-442 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Mixed-state rf loss measurements were made on controlled specimens to test the relation between "depinning frequency" as defined in the currently accepted models and the critical Lorentz force for pinning. Precipitation of the second phase from the supersaturated Pb-12.9 (atomic) % Sn solid solution increased magnetic irreversibility substantially but did not change the depinning frequency. (MHR)

13860 A. C. PERMEABILITY STUDIES OF TERNARY ALLOYS AT CRYOGENIC TEMPERATURES. Lepper, R.; Wolff, E. G.; Mills, G. J. (Northrop Corp., Hawthorne, CA). pp 461-467 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A differential ac permeability technique was developed and used to study the Shubnikov phase region in the Ti-6 Al-4V aircraft alloy. The effects of metallurgical processing and microstructure were correlated with critical temperature and complex permeability/susceptibility at applied fields up to 0.7 tesla. Control of the complex susceptibility (χ', χ'') and critical temperature (over the range ~1°K to > 4°K) could be independently achieved by control of the morphology of the various metallurgical phases obtainable through conventional heat treatments. Modification of the technique for studies in the range 0.3 to 77°K, for dc permeability and for critical current measurements are outlined. Implications for the control of superconducting properties of complex alloys for cryogenic devices are outlined, including methods to maximize T_c and minimize χ''. (auth)

13861 TEMPERATURE DEPENDENCE OF SUPERCONDUCTING CRITICAL CURRENT DENSITIES OF MULTIFILAMENTARY A-15 COMPOSITE WIRES. Crow, J. E.; Suenaga, M. (Brookhaven National Lab., Upton, NY). pp 472-476 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronic Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Recently it has been demonstrated that multifilamentary superconducting composites can be made with A-15 composites, thus significantly increasing the transition temperature and the critical field over that of conventional Nb alloy composites. Critical currents were measured as a function of temperature and magnetic field for composites containing filaments of Nb_3Sn and V_3Ga. The measured critical current densities for these composites are comparable with those for V_3Ga tapes and commercial Nb_3Sn ribbons. (auth)

13862 GEOMETRIC REDUCTION OF THE CRITICAL CURRENT DENSITY IN MULTIFILAMENT COMPOSITE SUPERCONDUCTORS. Walker, M. S. (Westinghouse Research Labs., Pittsburgh). pp 477-480 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Improved critical current stability and reduced ac losses have resulted from the construction of composites having many superconductor filaments embedded in a normal metal or alloy matrix. The losses are reduced by twisting the composites, and the twist pitch, L, is made small owing to an L^2 coupling loss dependence for sufficient twist. Composites with L as small as ten composite diameters are commonly made, but the need for more tightly twisted superconductors may arise. The present work shows, however, that there is a limit to the amount of twist that can usefully be employed, since the reduction of L changes the geometry of the superconductor in such a way that the effective critical current of the wire is also reduced. As L approaches several wire diameters the decrease in the critical current becomes severe. This geometric limit has been observed by us in NbTi-copper multifilamentary composite superconductors and is explained by the simple analysis which follows. Experimental data supporting the theory are also presented. (auth)

13863 LOW TEMPERATURE ELECTRON IRRADIATION OF MULTIFILAMENT SUPERCONDUCTORS. Schweitzer, D. G.; Parkin, D. M.; Garber, M.; Goland, A. (Brookhaven National Lab., Upton, NY). pp 491-494 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied supperconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Property changes in multifilament superconductors during and after 1 MeV electron irradiations at 3°K are described. The studies include measurements on direct and indirect heat transfer problems associated with irradiations where the sample is maintained in the superconducting state during irradiation. Techniques utilizing the properties of the superconductor were developed to obtain accurate values of the flux and sample temperature during irradiation. Changes in the critical current with temperature and in fields to 60 kilogauss are described. The large changes observed after initial electron irradiations were found to be caused by heating effects and not by defects produced by the electrons. The changes after irradiation are compared to similar changes which can be induced by short-term heat treatments. (auth)

13864 PROPERTY CHANGES IN MULTIFILAMENT SUPERCONDUCTORS DUE TO HIGH TEMPERATURE HEAT TREATMENTS AND ELECTRON IRRADIATIONS. Parkin, D. M.; Schweitzer, D. G. (Brookhaven National Lab., Upton, NY). pp 495-499 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Multifilament 50% Nb-Ti 50% Cu wires show large changes in critical current with heat treatments from 600°C to 700°C. Short heat treatments at 700°C reduce the value of I_c in an applied field of 40 kG to 27% of the as received value. Unclad stripped wires also show reductions in I_c. Measurements after 300°C 1 MeV electron irradiations to 10^{20} e/cm^2 show no changes in the value of I_c. (auth)

13865 MAGNETIC FIELD EFFECTS ON THE THERMAL CONDUCTANCES OF TYPE-II SUPERCONDUCTOR-COPPER JUNCTIONS. Chang, Y. W.; Frederking, T. H. K. (Univ. of California, Los Angeles). pp 500-504 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Magnetic field effects on the thermal conductances (h) of type-II superconductor/copper junctions were investigated up to the upper critical field H_{c2} (Nb). A Nb/Cu junction was formed by casting an upper Cu-cylinder to a lower Nb-cylinder. An external magnetic field (H) was applied perpendicular to the interface and parallel to the axis of the cylindrical vacuum-insulated specimen. Heat flowed along the axis from the Nb-cylinder to the Cu-cylinder placed in contact with liquid ^{4}He. In the Meissner state, h stayed constant up to the onset of flux line entry. After penetration of flux into the sample, h increased monotonically in the mixed state as H was raised to H_{c2}. Upon decrease of the field, h remained relatively large without returning to the value at zero applied field (indicating flux trapping). The thermal resistance of the junction was two to three orders of magnitude larger than the resistance of a Nb-cylinder segment with a height equal to the junction zone thickness. Similar experiments with commercial NbTi-Cu junctions showed a large thermal resistance independent of H up to 30 kOe at 2°K. At 4°K, h was of the order of magnitude 10^{-2} W cm^{-2}K^{-1} and smaller than the Nb/Cu-values. (auth)

13866 ALUMINUM STABILIZED Nb-Ti SUPERCONDUCTOR. El Bindari, A. (Supertechnology Corp., Boston). pp 512-515 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

It was demonstrated that Al can be coworked with a 50 at. % Nb-Ti alloy similar to Cu. Furthermore, the electrical properties of the superconductor at the onset of resistance are such that the substrates' electrical conductivity is relatively unimportant. Thus, Al can be substituted for Cu when lightweight applications are important, provided we solve the joinability problem. Multifilament conductors with Al as the substrate should offer no serious problem. (auth)

13867 STATUS OF SUPERCONDUCTIVITY FOR RF APPLICATIONS. Turneaure, J. P. (Stanford Univ., CA). pp 621-630 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The RF applications of superconductivity are reviewed. A discussion of the techniques of manufacturing superconducting cavities is given along with the results that were obtained in the frequency range of 100 MHz to 10 GHz. The superconductor Nb is emphasized. (auth)

13868 FREQUENCY DEPENDENCE OF ULTRASOUND ABSORPTION IN SUPERCONDUCTING ALLOYS WITH OVERLAPPING ENERGY BANDS. Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 35: No. 2, 431-433(1973). (In Russian).

The model of overlapping energy bands has previously proved successful for investigating a series of kinetic and thermal properties of superconductors. Experimentally observed frequency dependence of the coefficient of ultrasound absorption in superconductors is theoretically examined on the basis of a two-zone model. (KSW)

13869 SUPERCONDUCTIVITY OF TERNARY SULFIDES AND THE STRUCTURE OF $PbMo_6S_8$. Marezio, M.; Dernier, P. D.; Remeika, J. P.; Corenzwit, E.; Matthias, B. T. (Bell Telephone Labs., Murray Hill, NJ). Mater. Res. Bull.; 8: No. 6, 657-668(Jun 1973).

The compound $Pb_{0.92}Mo_6S_{7.5}$, a derivation from the ideal stoichiometric compound $PbMo_6S_8$, is a member of the ternary sulfide series $M_xMo_3S_4$ where M = Ag, Sn, Ca, Sr, Pb, Ba, Cd, Zn, Mg, Cu, Mn, Cr, Fe, Co, Ni, Li, Na, Sc, and Y. Members of the series with M = Pb, Sn, Ag, Cu, Zn, Mg, Cd, Sc, and Y have been found to be superconducting at T_c = 15.2, 14.2, 9.1, 10.9, 3.6, 3.5, 3.5, 3.6, and 3.0°K respectively. The lead compound has rhombohedral symmetry $R\bar{3}$, lattice parameters a = 6.551Å and α = 89.33°, and one formula per unit cell. The structure consists of a distorted primitive-cubic network of sulfur atoms with every fourth sulfur cube occupied by either a Pb atom or a Mo_6 octahedron. The vertices of the Mo_6 octahedron lie in the face centers of the sulfur cube which is tilted approximately 15° with respect to the rhombohedral axes. This arrangement yields open channels running through the structure parallel to the unit cell edges. Crystal data and transition temperatures are reported for $Mo_3S_{4-x}Se_x$ and boron-doped $M_xMo_3S_4$. (auth)

13870 I. ISOTOPE EFFECT OF SUPERCONDUCTORS Cd, Mo, AND Zn. II. Pressure Effects in Some Superconducting Elements. Palmy, C. Diss. Nr. 4546. Zurich; Eidgenoessiche Technische Hochschule (1970). 70p. (In German).

Thesis.

Investigations on the isotope effect of the superconductors Zr, Mo, and Cd are reported. The experimental results show a vanishing isotope effect in Zr and an intermediate one in Cd and Mo. These deviations from the normal isotope effect are well understood within the framework of the theory of Bardeen, Cooper, and Schrieffer if the Coulomb repulsion is included in the effective interaction. (auth)

13871 STACKING FAULTS IN A15 (β-W SUPERCONDUCTORS. Essmann, U.; Zerweck, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 57: No. 2, 611-616(1973).

In A15 structures $\frac{1}{2}\langle 111\rangle$ stacking-faults break the linear chains of A atoms. This affects the electronic structure resulting e.g. in changes of the superconducting critical temperature T_c. Moreover the large pinning forces observed in these compounds are attributed to the described planar defects. (auth)

13872 MICROSCOPIC MAGNETIC FIELD DISTRIBUTION IN SUPERCONDUCTING NIOBIUM SINGLE CRYSTALS IN THE DIRTY LIMIT. Weber, H. W.; Schelten, J.; Lippmann, G. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (b); 57: No. 2, 515-522(1973).

Neutron diffraction experiments on the flux lines in superconducting niobium single crystals varying in their Ginzburg–Landau parameter $\varkappa_1$ between 1.8 and 3.0 are reported. In all cases the flux line lattice was found to be single crystalline. Using the analysis of the integral reflectivities described previously the local magnetic field distribution is obtained as a function of the flux density. Comparing the results for different $\varkappa$ a systematic variation of the magnetic microstructure is observed: with increasing $\varkappa$ the attractive interaction between individual flux lines disappears, the maximum field decreases, and the minimum and saddle point fields increase; the linear superposition of the fields of single flux lines observed with $\varkappa \approx 4$ changes systematically into a nonlinear one at $\varkappa \approx 1$. Finally, the results on the "isolated" flux line are compared with theory. (auth)

13873 PROPERTIES OF TYPE-II SUPERCONDUCTORS DERIVED FROM A NONLOCAL THEORY. Brandt, E. H. (Max-Planck Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 57: No. 2, 465-475(1973).

Some properties of flux lines and of the flux-line lattice are derived from the nonlocal theory for type-II superconductors given in a previous article. The curvature of the magnetic field increases with decreasing temperature (even in reduced units), resulting in a sharp cusp at zero temperature and $B = H_{c2}$ (clean limit). At large distances from the vortex core the magnetic field reverses its sign for small $\varkappa$ and $T < 0.78\ T_c$, whereas the gap parameter increases monotonically to the BCS value. Both effects can separately explain the attraction of flux lines observed in experiment for small $\varkappa$ and T. (auth)

13874 THERMAL CONDUCTIVITY AND THE TEMPERATURE DEPENDENCES OF THE ENERGY GAPS OF NIOBIUM SAMPLES CONTAINING LARGE AMOUNTS OF IMPURITY ATOMS. Anders, E. E.; Sukharevskii, B. Ya.; Volchok, I. V. (Physical Technical Inst. of High Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1688-1698(May 1973). (In Russian).

A method is proposed for determining the temperature dependence of the energy gap on basis of data obtained for measuring the thermal conductivity of superconductors with a high impurity atom content. Results are presented of an investigation of the temperature dependence of the thermal conductivity of niobium (99.6%) and a solid niobium solution containing 1.7 at.% zirconium in the superconducting state, and also of the thermal conductivity of the samples in the 10 to 20°K temperature range. The dependence of the specific heat of the solid solution with 1.7 at.% zirconium on temperature between 2.5 and 18°K is presented. From the results obtained the temperature dependence of the energy gap of the samples is determined. Electron and lattice components of the thermal conductivity of the samples in the superconducting state are found. The contribution of phonon scattering by crystal structure defects to the lattice thermal resistance in the superconducting state is determined. (auth)

13875 EFFECT OF HIGH UNIFORM PRESSURE AND RESIDUAL STRESS ON THE SUPERCONDUCTIVITY OF ALLOYS OF THE $V_3(Si_{1-x}Ge_x)$ SYSTEM. Rabin'kin, A. G.; Galev, V. N.; Laukhin, V. N. (Inst. of Chemical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1724-1733(May 1973). (In Russian).

The dependence of the transition temperature to the superconducting state T_c on pressure (p up to 30 kbars) and compressibility is studied in $V_3(Si_{1-x}Ge_x)$ alloys. In all alloys T_c linearly depends on p. The magnitude of dT_c/dp linearly grows with the Ge content. It changes from 4.10^{-5} degree/bar in V_3Si to 7.10^{-5} degree/bar in V_3Ge. It is shown that the sharp concentration dependence of T_c in $V_3(Si_{1-x}Ge_x)$ alloys does not correlate with the variation of the mean atomic volume of the alloys induced by Ge doping of the alloys. This is in contradiction to the predictions regarding the behavior of the alloys under pressure or on alteration of their composition. Inhomogeneous uniaxial stresses on powder samples results in a strong broadening of the temperature range in which the superconducting transition occurs. The magnitude of the temperature range varies in a regular manner with variation of the composition, maximal expansion being observed in the V_3Si alloy. Some peculiarities of the effect are considered. (auth)

13876 HIGH FREQUENCY CURRENT STATES IN SMALL SIZE SUPERCONDUCTORS. Galaiko, V. P. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1824-1838(May 1973). (In Russian).

The Boltzmann kinetic equation for quasiparticles scattered by impurities which contains the self-consistent field of the superconducting order parameter is derived from the kinetic equation for the generalized electron–hole density matrix in the case of "pure" superconductors. After completion of the rapid formation of the superconducting condensate the equation describes nonlinear nonstationary processes in the system with frequencies $\omega \ll T_c$. The equation is employed for considering the problem of high frequency spatially homogeneous current states in small superconducting samples. The nonlinear response—a high frequency electric field corresponding to the given external current passed through the sample—is also found. (auth)

13877 FLUCTUATION THEORY OF THE TWO-DIMENSIONAL MIXED STATE OF A SUPERCONDUCTOR OF THE FIRST KIND. Andreev, A. F.; Bestgen, V. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1865-1880(May 1973). (In Russian).

The structure of the surface "mixed" state of Type-I superconductors is elucidated for conditions when, due to the presence of an electric field, the superconductivity is strongly suppressed and exists as superconducting fluctuations. It is shown that for currents close to the second critical current an arbitrarily weak electric field leads to practically complete destruction of the mixed state layer. The electromagnetic impedance of the surface in the presence of a mixed state layer is calculated. (auth)

13878 TUNNELLING OF ELECTRON PAIRS IN A SOUND FIELD IN SUPERCONDUCTORS. Urushadze, G. I. (Tbilisi State Univ., USSR). Zh. Eksp. Teor. Fiz.; 64: No. 5, 1880-1886(May 1973). (In Russian).

The effect of sound vibrations on a stationary Josephson current is considered. The dependence of the sound-induced effective tunnel current on sound frequency is investigated at absolute zero temperature. (auth)

13879 SUPERCONDUCTING FLUCTUATIONS AND THE PEIERLS INSTABILITY IN AN ORGANIC SOLID. Coleman, L. B.; Cohen, M. J.; Sandman, D. J.; Yamagishi, F. G.; Garito, A. F.; Heeger, A. J. (Univ. of Pennsylvania, Philadelphia). Solid State Commun.; 12: No. 11, 1125-1132(1 Jun 1973).

The discovery of extraordinary conductivity maxima in a class of organic charge transfer salts is reported. Results are given for (TTF)(TCNQ), where TTF = tetrathiofulvalene and TCNQ = tetracyanoquinodimethan. The data are interpreted as resulting from superconducting fluctuations at high temperatures. A possible mechanism for achieving high temperature superconductivity is suggested based on the electron–phonon interaction, in the strong-coupling limit, and the Peierls soft-mode instability in pseudo-one-dimensional systems. Procedures are suggested for the possible eventual stabilization of the superconducting state. (auth)

13880 FEASIBILITY OF TURBOGENERATOR WITH SUPERCONDUCTING ROTOR AND CONVENTIONAL STATOR. Lorch, H. O. (GEC Power Engineering Ltd., Stafford, Eng.). Proc. Inst. Elec. Eng. (London); 120: No. 2, 221-227(Feb 1973).

In a 660 MW turbogenerator, the losses associated with the rotor total some 4.5 MW, mainly due to direct current in the field winding. The feasibility of saving this by making the winding superconducting is examined. The stator coils carry alternating current, and so they cannot be made superconducting, and, in the concept proposed here, the stator is substantially conventional. The new rotor has no iron, except for shaft ends, and the winding

is embedded in an insulating cylinder cooled with liquid helium from a refrigeration plant. The winding is protected from harmful ac fields by a copper cylinder which rotates with it. The gap is evacuated, and this screening cylinder is kept cold by thermal conduction in the residual gas to a stationary low-temperature shield. The machine has high steady-state- and transient-stability margins, and the need for rapid field changes is greatly diminished. The new rotor allows the present stator to be uprated. The economic advantage of the machine, taking refrigeration into account, depends on the degree of uprating found possible, and is in the range £290 000 to £830 000 for an output range of 660 to 1000 MW. Many problems, particularly of a mechanical nature, remain to be solved, but none appears insuperable. (auth)

13881 PARAELASTIC INTERACTION BETWEEN LATTICE DEFECTS AND FLUX LINES. Kronmueller, H.; Schmucker, R. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 57: No. 2, 667-679(1973).

Within the framework of the micromagnetic theory of superconductivity explicit expressions for the elastic stresses of flux lines are derived. The dependence of the stress tensor on the superconducting parameters λ, ξ, and $\varkappa$ is discussed. It is shown that the magnetic pressure associated with the magnetic field gives rise to elastic stresses of the same order of magnitude as the contribution from the $\Delta V/V$ effect of the order parameter. Explicit expressions are derived for the pinning forces exerted by dislocations on flux lines. They are found to be approximately proportional to the condensation energy $H_c^2/8\pi$. (auth)

13882 DIFFERENTIAL PARAMAGNETIC EFFECT IN PURE TANTALUM. Weber, J. L.; McEvoy, J. P. (Clark Univ., Worchester, MA). Phys. Status Solidi (b); 57: No. 2, K87-K91(1973).

Results are presented of a study of the response of a pure Ta crystal to a small ac field. The imaginary part χ^{11} of the complex susceptibility was measured using a coil pair apparatus, and the temperature variation (4.2, 3.685, 3.463, and 3.193°K) of the differential paramagnetic effect (DPE) is shown. The effect of the superconducting surface sheath is considered. The temperature at which H_{c3} exceeds H_c was determined to be 3.74°K. The discrepancy between the DPE of Ta and Sn is explained, and previous studies of the ac properties of superconducting Ta are discussed. (DLC)

13883 MAGNETIC FIELD ENHANCEMENT OF SUPERCONDUCTING FLUCTUATION CONTRIBUTIONS TO $1/T_1$. Shenoy, S. R. (Yale Univ., New Haven). Phys. Lett.; 44A: No. 1, 33-34 (7 May 1973).

A magnetic field enhances the fluctuation contribution to $1/T_1$ of a clean bulk superconductor close to $T_{c2}(H)$, changing the zero-field nondivergent temperature dependence to divergent behavior $\sim\epsilon_H^{-\frac{1}{2}}$. (auth)

13884 OSCILLATION SPECTRUM OF FLUX LINES IN PURE SUPERCONDUCTORS. Baramidze, G. A. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: No. 1, 57-60(Apr 1973). (In Russian).

The longwave spectrum of flux lines in pure superconductors was studied using the nonstationary generalization of Bogolyubov's microscopic equations. It is shown that there exists an excitation branch with the quadratic dispersion law. The coefficients of the dispersion equation near the critical temperature are estimated. The order of these coefficients agrees with the hydrodynamic limit. (auth)

13885 EFFECTS OF FERROMAGNETIC LAYERS UPON TUNNELING IN SUPERCONDUCTING LEAD JUNCTIONS. Guess, J. F. Stillwater, OK; Oklahoma State Univ. (1972). 89p. University Microfilms Order No. 73-15,128.

Thesis (Ph. D.).

Tunneling in superconducting lead junctions is reviewed with particular emphasis upon the interaction of ferromagnetic material with the superconducting state. Experimental techniques are described for the fabrication of samples and methods of measurement. A survey of observed phenomena in lead/lead oxide/lead junctions produced methods of characterizing junction behavior which are applicable to other types. A study of the proximity effect by the tunneling technique has shown that the perturbation penetrates the superconducting lead a characteristic distance which is associated with the coherence length of the superconducting state. Some interesting effects which have been observed in junctions containing ferromagnetic material and their possible origins are discussed. (Diss. Abstr. Int., B)

13886 EXPERIMENTAL STUDY OF THE RIEDEL SINGULARITY AND QUASIPARTICLE DAMPING EFFECTS IN VERY SMALL JOSEPHSON TUNNEL JUNCTIONS. Buckner, S. A. Philadelphia; Univ. of Pennsylvania (1972). 218p. University Microfilms Order No. 73-14,384.

Thesis (Ph. D.).

A study is presented of the effects of quasiparticle damping processes and gap anisotropy in very small Josephson tunnel junctions. The results of measurements of the Riedel singularity in Sn/Sn oxide/Sn tunnel junctions are that at low temperatures the singularity is removed by gap anisotropy and that the value of gap anisotropy found agrees with calculated values. At high temperatures quasiparticle damping processes are dominant and the results agree with theoretical estimates of these effects. Another quantity which reflects quasiparticle damping processes and gap anisotropy is the slope (dI/dV) of the quasiparticle current at $eV = 2\Delta$. The results of measurements of this quantity, however, indicate the presence of an additional damping mechanism for single-particle tunneling. (Diss. Abstr. Int., B)

Equipment and Devices

Refer also to abstracts 13443, 13846, and 13867.

13887 LENGTH DEPENDENCE OF CRITICAL CURRENT IN THIN SUPERCONDUCTORS. Fink, H. J. (Univ. of California, Davis). Physics Letters; 43A: No. 6, 523-524(23 Apr 1973).

The critical current and its dependence on the length of a thin superconducting wire between two normal metals and the voltage difference across the wire at the critical current is calculated. The latter arises from the conversion of the normal current into supercurrent and vice versa at the contacts. It is found that the critical current is zero when the length of the wire is π coherence lengths or smaller. (auth)

13888 SUPERCONDUCTING TUNNEL JUNCTIONS AS VERY FAST DETECTORS. Adkins, C. J. (Cavendish Lab., Eng.). Physics Letters; 43A: No. 6, 537-538(23 Apr 1973).

Superconducting tunnel junction detectors biassed on the gap edge have a response time of the order of 1 ns and a sensitivity comparable with that achieved in the conventional mode of operation. (auth)

13889 HIGH CRITICAL MAGNETIC FLUX DENSITIES IN SINGLE PIECE TM_{010}-X-BAND CAVITIES OF NIOBIUM. Martens, H.; Diepers, H.; Hillenbrand, B. (Siemens Research Laboratories, Erlangen, Ger.). Phys. Lett.; 44A: No. 3, 213-214$_0$ (4 Jun 1973).

In single piece TM_{010}-X-band niobium cavities critical magnetic fields of 90 mT with Q_0's of 5×10^9 were obtained. For a cold-prepared cavity, filled with helium gas, the corresponding values were 130 mT and 2.1×10^9. (auth)

13890 STATUS OF SUPERCONDUCTING MACHINES AT IRD: SPRING 1972. Appleton, A. D. (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). pp 16-25 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The development of superconducting machines at International Research & Development Co. Ltd., since 1963 is summarized. The work has been carried out on behalf of the Ministry of Defence (Navy), the National Research Development Corporation and C. A. Parsons & Co. Ltd. In 1966 a 50 hp model superconducting homopolar motor was commissioned, and in 1971 full load tests were performed on a 3250 hp motor (the Fawley motor). At the present time IRD is engaged upon the construction of two superconducting dc machines, one motor and one generator, for a marine propulsion system which will undergo sea trials in 1973. In addition to the above, IRD has been engaged upon the development of superconducting ac generators since 1968. It is shown that there are crucial aspects of superconducting dc machines which determine the nature of a development program; these are discussed together with some equally important but less critical aspects. Discussions on the marine propulsion system and the Fawley motor are included and a brief mention is made of superconducting ac generators. (auth)

13891 SUPERCONDUCTIVE NAVAL PROPULSION SYSTEMS. Levedahl, W. J. (Naval Ship Research and Development Center, Annapolis, MD). pp 26-32 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The effects of turbine combinations on the cruising range and top speed of a hypothetical 400 foot, twin-screw attack vessel of 1500 ton fuel capacity were studied. Two 3500 hp, 9000 r/min gas turbines and four 25,500 hp, 3600 r/min machines were assumed to be operable in any combination, cross-connectible to the two screws. (MHR)

13892 SUPERCONDUCTIVE SHIP PROPULSION SYSTEMS. Fox, G. R.; Hatch, B. D. (General Electric Corp., Schenectady, NY). pp 33-40 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Electrical ship propulsion systems are a particularly attractive area for applying superconductivity. The many advantages of electrical ship propulsion systems can be obtained, and the increased power density and economies possible with superconductive machines permit an even greater flexibility in new ship designs. Both dc and ac propulsion systems are possible and hybrid systems (ac generator and dc motor) may also be considered. Experiments have demonstrated the operation of two superconductive dc generators and have also provided new information for the design of liquid metal current collectors for large currents in high intensity fields. The refrigeration cycles that may be employed to provide continuous cryogenic cooling are presented. In particular, components for a turborefrigerator for long life and high reliability are discussed, and the characteristics of the turborefrigerator are discussed. (auth)

13893 AIRBORNE AC SUPERCONDUCTING GENERATOR. Lowry, L. R. (Westinghouse Electric Corp., Lima, OH). pp 41-46 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

An ac generator utilizing a rotating superconducting field is described. The generator will produce 1000 kVA at 5000 volts. 3 phase, 400 Hz with a short time overload capability of 5000 kVA. Predicted performance, size, and weight of the superconducting generator are compared with that of a machine of similar rating using conventional airborne generator technology. It is concluded that superconducting generators will exhibit significant weight reductions for generators rated above 2 MW. (auth)

13894 SUPERCONDUCTING CONSIDERATIONS IN ROTATING ELECTRICAL MACHINES. Stekly, Z. J. J. (Magnetic Corp. of America, Cambridge, MA). pp 47-56 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The problems associated with superconducting field windings are discussed. The basic requirements for the field are discussed in terms of size, magnetic energy stored, power level, speed of rotation, number of poles. While the field winding is basically dc in nature, it is exposed to time varying magnetic fields and forces due to the armature currents generated by loading transients, faults, unbalanced electrical loads, as well as load generated harmonics. The effect of these on the design of the field as well as on the performance of the superconductor is discussed. (auth)

13895 ROLE OF SUPERCONDUCTING MAGNETS IN TRACKED MAGNETIC CUSHION VEHICLES FOR HIGH SPEED TRANSPORTATION. Reitz, J. R. (Ford Motor Co., Dearborn, MI). pp 57-61 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Magnetic levitation as a suspension mechanism for high speed vehicles is reviewed. Important parameters are magnetic lift per unit magnet weight, lift-to-drag ratio, and suspension height. The effect of vehicle-track clearance on ride quality is discussed, and the advantages of a large clearance are demonstrated. Superconducting magnets, because of their high-field-strength per unit weight, are particularly suited to this application. Specific problems resulting from the use of superconducting magnets are discussed. (auth)

13896 MAGNETIC LEVITATION OF HIGH SPEED GROUND VEHICLES. Coffey, H. T.; Chilton, F.; Hoppie, L. O. (Stanford Research Inst., Menlo Park, CA). pp 62-75 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Two nonsuperconducting and four superconducting magnetic levitation systems were studied to determine the technical feasibility of levitating a 100,000-lb vehicle. Each of these systems was found to be technically feasible but each had widely varying characteristics that made a definitive choice between them impossible without additional information. The system using superconducting magnets on the vehicle and a conducting sheet guideway appeared to be the best choice based on the information available, and the characteristics of this system were studied in detail. The cryogenic requirements and the design of a completely stabilized superconducting magnet were emphasized and were found to be technically feasible and quite reasonable. (auth)

13897 MAGNEPLANE: GUIDED ELECTROMAGNETIC FLIGHT. Kolm, H. H.; Thornton, R. D. (Massachusetts Inst. of Tech., Cambridge). pp 76-85 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A cylindrical vehicle equipped with superconducting coils is suspended resiliently by eddy current repulsion one foot above a cylindrical, trough-shaped aluminum guideway surrounding the lower third of the vehicle's circumference. The vehicle is free to roll so as to assume the correct bank angle in curves. It is propelled by a travelling magnetic field generated by current loops which form an integral part of the guideway. This field is synchronized by wayside control units on the basis of information transmitted from the vehicle; it reacts against the superconducting vehicle coils to provide synchronous acceleration, deceleration or cruise, and also generates vertical and lateral forces to apply active damping to oscillations in the heave, sway, pitch, yaw and roll modes. Lift-to-drag ratio is about 20 at 250 mph, propulsion efficiency is about 80%, and guideway loading is about 2 psi. Due to the uniform distribution of vehicle weight and the large suspension clearance, guideway alignment and rigidity are not very critical. This makes possible a reasonably priced active guideway. It weighs about as much as conventional rails (100 pounds per foot), requires no additional support structure, and can be laminated continuously from rolls of aluminum and fiberglass, suitably folded and interleaved. The vehicle is carried on retractable wheels until it reaches a velocity of about 40 mph; it can be operated in the open up to 300 mph, and in a partially evacuated tunnel up to and beyond jet aircraft speeds. On the basis of detailed study, it is believed that the magneplane represents an economically viable transportation system realizable with existing technology and superior to any of the alternatives presently under construction or development. (auth)

13898 CONCEPTUAL DESIGN OF A 750-TON HYDROFOIL UTILIZING A SUPERCONDUCTING MAIN PROPULSION SYSTEM. Liang, S. T. W.; Martin, L. F. (Naval Ship Research and Development Center, Bethesda, MD). pp 86-92 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The conceptual design of a 750-ton hydrofoil utilizing a superconducting main propulsion system is described. This is a fully integrated design concept in which the superconducting machinery is introduced into the ship system design at its very inception. The critical areas evaluated are ship configuration, performance, propulsion system, propulsor, and auxiliary systems. The study results show that use of a superconducting power system for propelling a large hydrofoil has many advantages: greater endurance, lighter weight, and more flexible arrangement. (auth)

13899 FLOODED ROTOR, DIRECT CURRENT ACYCLIC MOTOR, WITH SUPERCONDUCTING FIELD WINDING. Chabrerie, J. P.; Fournet, G.; Mailfert, A. (Laboratoire de Genie Electrique, Paris). pp 93-97 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Several studies performed since 1966 by the LGEP and LCIE have led to the development of a 60 kW flooded rotor homopolar motor operating at low speed (600 r/min). This machine uses multiple discs and superconducting field winding. After a short description of the model motor, and a brief account of the main test results, some problems due to the coexistence of a high

magnetic field, nonferromagnetic materials, and liquid metal, are examined. The overpressure phenomena due to the rotation of the lateral liquid rings, as well as the electromagnetic devices installed in order to suppress this inconvenience are discussed. The paper concludes with some comments on the choice of liquid metals and their applications to more powerful machines. (auth)

13900 PROPOSED PROPULSION SYSTEM FOR MAGNETICALLY LEVITATED GUIDED GROUND TRANSPORTATION. Atherton, D. L. (Queen's Univ., Kingston, Ont.). pp 110-112 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A propulsion system, using a controlled variable-speed linear synchronous motor, is proposed for magnetically levitated guided ground transportation systems. The motor may be integrated with the magnetic levitation system which will use superconducting magnets for high speed systems. The motor concepts are described together with its local, remote or preset control features and inputs. The motor can be self-starting and regenerative braking is possible. System control, safety aspects and a mechanical analog are discussed for the magnetic levitation application. It is concluded that the attractive control features and low speed starting performance may more than offset the increased cost of the semiconductor power switching circuits which are required. (auth)

13901 ELECTROMAGNETIC LIFT AND DRAG FORCES ON A SUPERCONDUCTING MAGNET PROPELLED ALONG A GUIDEWAY COMPOSED OF METALLIC LOOPS. Hoppie, L. O.; Chilton, F.; Coffey, H. T.; Singleton, R. C. (Stanford Research Inst., Menlo Park, CA). pp 113-119 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

An exact solution to the problem of a single constant current magnet (or group of magnets) moving uniformly along a guideway of metallic loops has been obtained and programmed for computerized results: single layer, double layer, or ladder tracks can be analyzed. The actual current in the loops as well as the actual lift and drag forces are obtained. (auth)

13902 THREE-PHASE-SYNCHRONOUS ALTERNATOR WITH SUPERCONDUCTING FIELD WINDING. Eckert, D. (Zentralinstitut fuer Festkoerperphysik und Werkstofforshung, Dresden); Endig, M.; Mueller, G.; Seidel, W. pp 128-135 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The superconducting field winding is a quadrupole magnet partially stabilized, having a field gradient of 55 Tesla/m and is assembled vertically. The armature is constructed as a cup with the cryostat in its inner space and rotating at 1500 rpm. The measured maximum power was 21 kVA. There is no iron in the alternator. In spite of the mechanical forces and the 200 A-leads the helium losses amounted to 15 l/min (gaseous) only at full-power. The alternator was successfully tested working on a passive network. With two phases only the helium losses amounted to 21 l/min. Working synchronized and directly connected to the municipal power supply system was successful, too. By sudden changes of the load or shortcircuiting the armature at reduced power no disturbances of the superconducting magnet were observed. The field winding could be switched on and off without quenching (time constant: 2 seconds). (auth)

13903 REVIEW OF THE CRITICAL ASPECTS OF SUPERCONDUCTING AC GENERATORS. Appleton, A. D.; Anderson, A. F. (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.). pp 136-144 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The development of superconducting generators undertaken by IRD on behalf of C. A. Parsons and Company Ltd. is reviewed. An outline drawing of a machine concept is presented with a discussion of the more critical development problems. An account is given of the manner in which preformance is influenced by machine geometry, in particular by inter-winding coupling factors on substransient reactance. The principal mechanisms causing machine losses are reviewed and the techniques used for their prediction and minimization are outlined. (auth)

13904 MIT-EEI PROGRAM ON LARGE SUPERCONDUCTING SYNCHRONOUS MACHINES. Smith, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge); Kirtley, J. L. Jr.; Thullen, P.; Woodson, H. H. pp 145-150 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A progress report is presented on the program to demonstrate the feasibility and potentials for the application of superconductors in the rotating field windings of large central-station synchronous generators. A brief history of the program and a synopsis of previously reported results are given. The second experimental machine (approximately 2 MVA) is described and progress on its construction and testing is given. (auth)

13905 SUPERCONDUCTOR SYNCHRONOUS GENERATORS. Mole, C. J.; Haller, H. E. III; Litz, D. C. (Westinghouse Electric Corp., Pittsburgh). pp 151-157 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The fundamental characteristics and operating modes of superconducting synchronous generators are reviewed for several applications. The applications of these machines are discussed together with auxiliary equipment such as the refrigeration and cryogenics systems. (auth)

13906 PRESSING NEED FOR BETTER AND LESS EXPENSIVE UNDERGROUND TRANSMISSION. Corry, A. F. (Boston Edison Co.). pp 160-164 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Future transmission systems will handle larger blocks of electric power and a greater percentage will be installed underground. Capabilities and costs of current systems are presented and installed cost goals are discussed. The importance of continued effort in this field is stressed. (auth)

13907 RESEARCH AND DEVELOPMENT OF SUPERCONDUCTING CABLES FOR HIGH POWER TRANSMISSION. Dubois, P. (Compagnie Generale d'Electricite, Marcoussis, France); Eyraud, L.; Carbonell, E. pp 173-193 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Work done on cryocables by Compagnie Générale d'Electricité and Air Liquide: design of several types of DC and AC superconducting cables; measurements on powders for thermal insulation; measurements of the dielectric properties of vacuum and solids in helium; measurements on cable samples; construction and testing of a full scale model of pipes and thermal shields are reviewed. (auth)

13908 MECHANICAL DESIGN OF TUBULAR CONDUCTORS FOR AC SUPERCONDUCTING POWER TRANSMISSION. Baylis, J. A. (Central Electricity Research Lab., Leatherhead, Eng.). pp 182-193 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The major mechanical problems in the design of tubular conductors for superconducting cables are the thermal contraction and the electromagnetic forces which act during fault currents. This paper is concerned with thermal contraction, and various methods of dealing with it are analyzed and discussed. Special Ω bends in the conductor route seem the best solution. The electromagnetic forces are shown to fix the permissible tolerance on conductor straightness, and to determine the maximum distance between conductor supports. (auth)

13909 AC SUPERCONDUCTING POWER TRANSMISSION. Meyerhoff, R. W. (Union Carbide Corp., Tarrytown, NY). pp 194-201 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The development and present status of the program to develop underground ac superconducting power transmission lines being carried out by the Linde Division of the Union Carbide Corporation are reviewed. The following topics are covered: previous program, present program, systems analysis, dielectric system development, conductor development, termination development and cryogenic system development. (MHR)

13910 LARGE COMPOSITE CONDUCTORS FOR AC SUPERCONDUCTIVE POWER TRANSMISSION. Graeme-Barber, C.; Maddock, B. J. (Central Electricity Research Labs., Leatherhead, Eng.). pp 211-212 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Tubular niobium clad copper conductors with diameters up to 100 mm have been developed. Such sizes are equivalent to cable power ratings of a few GVA. Two production methods have been used: one based on extrusion, the other on forming the tube from a composite strip. Measurements on a sample of the 50 μm niobium surface layer taken from one of the tubes indicate that the ac power losses of these conductors will be satisfactorily low. The most important development still required is the improvement of the overload current capacity. (auth)

13911 DEVELOPMENT OF LARGE SUPERCONDUCTING DC MAGNETS IN EUROPE: PRESENT AND FUTURE APPLICATIONS. Bogner, G. (Siemens AG, Erlangen, Ger.). pp 214-226 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The state of development work is demonstrated by way of example of a number of magnet installations built for experiments in high-energy or plasma physics or which are shortly to be commissioned. The experience gained with large cylindrical magnets of fully stable NbTi-copper composite conductors has shown that such magnets can be manufactured on an industrial scale and that they can operate fully satisfactorily. This satisfactory operation is also expected of two magnet units with energy contents of 50 and 800 MWs which are shortly to be commissioned. Remarkable successes have also been achieved with larger intrinsically or partially stable magnet systems with high current densities, though setbacks have also been experienced in this area. Results obtained so far have led to the conclusion that intrinsically stable and twisted NbTi-copper conductors with a copper-to-superconductor ratio of at least 2 : 1 should be used for such magnets and that the magnet winding packets must be carefully fixed (impregnated) and reinforced, as well as adequately cooled. In addition to individual projects in the high-energy and plasma physics fields, development programs have been started in recent years aiming at the use of superconducting magnets in the solution of other problems in the electrical engineering field. These include theoretical and experimental studies in Germany on the magnetic suspension and guidance of highspeed track-bound land vehicles. With the aid of models and prototypes in France, and particularly in the U.K. it has been proven that light-weight, space-saving and high-performance homopolar dc machines with superconducting field coils can be built. One particularly interesting example of this is the 2400 kW motor of the IRDC. The same company is at present building a motor-generator system for marine propulsion drives. Paper studies on large synchronous machines with superconducting field coils also show promise. Studies are also in progress on the use of superconducting magnets as inductive energy storage systems in quasi-stationary or pulsed installations. Magnetic separation is also likely to be the subject of interesting studies in the near future. (auth)

13912 PULSED SUPERCONDUCTING MAGNETS. Brechna, H.; Green, M. A. (Kernforschungszentrum, Karlsruhe, Ger.). pp 226-238 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The progress which has been made on pulsed superconducting magnets and ac composite conductors is reviewed. The performance of prototype pulsed dipoles is described. Future trends in the design of pulsed superconducting magnets are indicated. (auth)

13913 NAL BUBBLE CHAMBER MAGNET. Percell, J. R.; Desportes, H. (Argonne National Lab., IL). pp 246-250 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The design of the superconducting magnet for the 30,000 liter NAL bubble chamber is described. The magnet has a winding bore of 14 ft with a central field of 30 kG. Peak field on the conductor is 51 kG and the operating current is 5,000 amperes. The finished magnet with cryostat will weigh 140 tons with 88 tons of this as coils. (auth)

13914 PERSISTENT CURRENT DECAY IN A SUPERCONDUCTING COIL DUE TO EXTERNAL MAGNETIC FIELD OSCILLATIONS. Andrianov, V. V.; Zenkevich, V. B.; Kurguzov, V. V.; Sytchev, V. V.; Ternovskii, F. F. (Inst. of High Temperatures, Moscow). pp 250-255 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The variation of the induction distribution in a two-layer short-circuited coil which is assumed to be infinitely long is considered. The effects were checked experimentally in a triple-layer inductance coil featuring an inner diameter of 10 mm and length of 72 mm and wound from a copper-plated wire of the alloy 65 BT, 0.27 mm in diameter over the superconductor, with the copper plating thickness of 0.04 mm. Experiments were also carried out with a single-layer short-circuited solenoid. (MHR)

13915 CURRENT-CARRYING CAPACITIES OF V_3Ga SUPERCONDUCTING SOLENOIDS. Fukuda, S. (National Research Inst. for Metals, Tokyo); Tanaka, Y.; Tachikawa, K.; Iwasa, Y. pp 256-260 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The current-carrying capacities of V_3Ga tapes and wires in short samples and in pancakes or coils are reported. Single pancakes were wound of tapes of either 5-m or 100-m length—these lengths represent steps leading toward the production of the much longer pieces needed for the construction of magnets of practical size. Coils contained wire of 120-m length. (MHR)

13916 SUPERCONDUCTING MAGNET FOR A Ku-BAND MASER. Berwin, R.; Wiebe, E.; Dachel, P. (Jet Propulsion Lab., Pasadena, CA). pp 266-269 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A superconducting magnet to provide a uniform magnetic field of up to 8000 G in a 1.14-cm gap for the 15.3-GHz (Ku-band) traveling wave maser is described. The magnet operates in a persistent mode in the vacuum environment of a closed-cycle helium refrigerator (4.5°K). The features of a superconducting switch, which has both leads connected to 4.5°K heat stations and thereby does not receive heat generated by the magnet charging leads, are described. (auth)

13917 DESIGN FEATURES OF SUPERCONDUCTING TRANSPORT AND ANALYSIS MAGNETS. Fast, R. W.; Heim, J. R. (National Accelerator Lab., Batavia, IL). pp 270-272 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The design features of a 2.0 kG/cm cold iron beam transport quadrupole and of a 18 kG, wide aperture particle analysis dipole are given. Operating currents of 250 and 350 amps, respectively, were chosen, corresponding to conductor current densities of 19.7 and 27.6 kA/cm^2. Coil construction provides good conductor cooling and supports the large electromagnetic forces. Rectangular cryostats to provide a large LHe volume above the coil have been used and have proven to be both inexpensive to construct and of low heat leak. A column support capable of reacting large loads to room temperature with negligible heat leak has been used. (auth)

13918 SLAC TWO-METER DIAMETER, 25-KILOGAUSS, SUPERCONDUCTING SOLENOID, UAMH BINN. Alcorn, J. S.; Petersen, H. O.; St. Lorant, S. J. (Stanford Univ., CA). pp 273-276 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The following topics are covered: the solenoid overall design, the superconductor design, the coil construction, helium vessels, refrigeration, magnet parameters, and iron flux return path. (MHR)

13919 AC3: A PROTOTYPE SUPERCONDUCTING SYNCHROTRON MAGNET. Wilson, M. N.; Hopes, R. B.; Stovold, R. V.; Gallagher-Daggitt, G. E.; Tolcher, R.; Lawler, J. V.; Brown, J.; Edwards, V. W. (Rutherford Lab., Didcot, Eng.). pp 277-282 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

A pulsed superconducting dipole magnet has been built which fulfills many of the requirements of a synchrotron accelerator. It produces a field of ~4T in a bore of 100 mm at a current of ~5000 A and may be pulsed with a rise time of ~1 second. The hysteresis loss per cycle is ~50 joules. (auth)

13920 CONSEQUENCES OF REPLACING CONVENTIONAL MAGNETS BY SUPERCONDUCTING MAGNETS IN AN EXISTING SYNCHROTRON. Bronca, G.; Neyret, G.; Parain, J.; Perot, J. (CEN, Saclay, France). pp 283-292 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

In order to increase the energy of an existing synchrotron it is possible to replace conventional magnets by superconducting magnets operating at higher magnetic field. With niobium–titanium superconducting materials the sensible limit of the maximum field is 6 to 8 teslas. For the present CERN II synchrotron, a central field of 6 T will allow us to reach 1200 GeV, including straight sections to accommodate multipole correcting magnets. Main ring superconducting magnets with the same aperture as conventional magnets will allow us to use all existing equipment, such as the radio frequency system, the power supply and the control system. With these changes, a longer cycle duration is required; for the 1200 GeV synchrotron a cycle of about 80 seconds was chosen. (auth)

13921 CONSTRUCTION OF A SUPERCONDUCTING QUADRUPOLE DOUBLET: O.G.A. Bronca, G.; Hamelin, J.; Neel, J.; Parain, J.; Renard, M. (CEN, Saclay, France). pp 288-292 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

A quadrupole doublet of large angular acceptance was constructed during the last years at the Laboratory. The basic parameters of the two independent quadrupoles are a field gradient of 35 and 23 T/m in a useful diameter respectively of 20 and 30 cm and a magnetic length of 68 cm. The conductor using niobium–titanium material was made of twisted filaments each of 45 microns diameter. Experience achieved from the different states of construction will be reported with results of cryogenic and magnetic measurements made on the assembled quadrupoles. This doublet must be inserted in a secondary beam of the 3 GeV synchrotron to increase the production of charged pions. An expected gain of four has been considered in the project. (auth)

13922 PROTOTYPE HIGH GRADIENT SUPERCONDUCTING QUADRUPOLE FOR HYPERON FOCUSING. Strauss, B. P.; Oram, R. W. (National Accelerator Lab., Batavia, IL). pp 300-301 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The construction is described of a prototype quadrupole magnet source 50 cm in length for use as a dc magnet for a proposed focused Cherenkov counter as well as possible use in an energy booster for the NAL synchrotron. It is of the "Super-ferric" type with cold iron laminations and tightly wound coils. It furthermore includes a new method for both reacting the magnetic forces and centering the coils. (MHR)

13923 DESIGN OF A 16T HYBRID MAGNET. Hanley, P. E. (Oxford Instrument Co. Ltd.). pp 302-307 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The design of a magnet system consisting of a 2 inch bore 9.3T water-cooled magnet within the room temperature bore of a 6.7T superconducting solenoid is described. It is shown that this combination is the most effective way of extending a 2 MW high-field laboratory facility with regard to cost and reliability. The forces arising from an asymmetrical failure of the inner magnet and the method of containing them are discussed. It is shown that these forces can be minimized by using a water-cooled magnet consisting of concentric helices instead of the more usual Bitter form of construction. The cryostat for the outer magnet is described, and also the refrigeration system using a Philips PGH 105 cryogenerator. The superconducting magnet is to consist of discs wound from Nb–Ti multifilament superconductor stacked to form a solenoid. Adiabatic and cryostatic stabilization are discussed, and it is shown that an optimum cooling channel width exists. Finally, the instrumentation for the operation of the hybrid magnet system is described. (auth)

13924 RESULTS OF TESTS ON THE SUPERCONDUCTING PART OF A HYBRID MAGNET. Leupold, M. J.; Iwasa, Y.; Montgomery, D. B. (Massachusetts Inst. of Tech., Cambridge). pp 308-312 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The magnet was cooled to liquid helium temperature and operated to 58 kilogauss, where it quenched. Cooldown from room temperature to 4.2K was accomplished in three steps. In the first the magnet container was filled with liquid nitrogen for cooling to 77K. Next, the nitrogen was pumped to reduce the temperature to 65K. Finally the magnet was filled with liquid helium. Data taken during cooldown have been compared with calculated performance. The description of the procedures serves as a guide to the operation of the system. (auth)

13925 GLASS REINFORCED EPOXY STRUCTURE FOR A LIGHTWEIGHT SUPERCONDUCTING DIPOLE MAGNET. Atherton, D. L.; Gluck, D. (Ferranti Packard Ltd., Toronto). pp 313-319 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

The mechanical structure for a 6.5 tesla, 33 cm winding bore, 102 cm magnetic length superconducting dipole magnet is presented. The saddle-coil magnet, which is intended for airborne magnetohydrodynamic power generators, is restricted to a total mass of 453.6 kg. Details of materials selection and testing are given. Magnetic stress analysis includes Lorentz, pinch, and end repulsive forces. Structural design covers bending moments, tensile and shear stresses and deflections of the filament wound structure internal and external to the windings with emphasis on high stresses (10^9 N/m^2 tensile) and light weight. Jigs and development tests of sample structures are described and interlaminar shear is examined in detail. Fabrication is described. It is shown that the use of filament wound high strength glass-epoxy composite gives very high specific strength, considerable cost savings and is particularly well suited to the mechanical structures needed for large superconducting magnets. (auth)

13926 DESIGN AND MODEL TESTS FOR A 5 TESLA SUPERCONDUCTING SADDLE MAGNET. Thome, R. J.; Stekly, Z. J. J. (Magnetic Corp. of America, Cambridge, MA). pp 320-324 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513–.

A lightweight superconducting saddle magnet has been designed and is currently under construction. A discussion of the magnet design and of model test results is presented. The magnet is designed to be mounted in a dewar with a horizontal, 0.18 m diameter, room temperature bore. The design central flux density of 5 Wb/m^2 is uniform within 10% over an axial length of 0.88 m and to within 25% over a length of 0.98 m which is the distance between magnet end turns. The overall winding current density is 1.5×10^8 A/m^2 at an operating current of 485 A and the peak flux density at the windings is 7 Wb/m^2. System weight and size were reduced by utilizing titanium and high strength aluminum for the magnet support structure and by using an aluminum dewar with helium vapor cooled radiation shield. The magnet windings are conduction cooled with no internal cooling passages. (auth)

13927 PERFORMANCE OF Nb_3Sn TEST COILS FOR LEVITATED MULTIPOLES, IN L.He AND IN He GAS UP TO 17K. Rau, F.; Jackel, H. J.; Martinelli, A. P.; Wipf, S. L. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 325-330 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

For the preparation of the plasma physics multipole experiment Wendelstein 6 (W 6) which uses two concentric levitated superconducting rings the performance of Nb_3Sn tape wound coils is studied in the temperature range 4.2 to 17 K. The test coils investigated consist of different numbers of double pancakes made from 5 mm wide G.E. tape with 22 cm ID and 32 cm OD. Below about 11 K the quenches are caused by magnetic instability determined by a critical value of the maximum radial field B_{Rmax} almost independent of conductor rating, coil geometry and operation in liquid or gaseous He. Depending on the charging rate B_{Rmax} is 15 to 22 kG, in a few cases 27 ± 1 kG, in L.He. With increased temperature B_{Rmax} decreases to 14 ± 4 kG at 11 K and to 8 ± 3 kG at 14 K. Interleaving the windings with aluminum tape 30 and 50 μ thick in an effort to stabilize the coils did not significantly alter the quenching behavior although the same fields are reached with less superconducting tape. The anticipated operation of the W 6 device is discussed on the basis of these test results. In a specific mode of W 6 operation an improvement is expected when using aluminum interleaved superconductor. (auth)

13928 OPERATION OF THE LEVITATED SUPERCONDUCTING RING IN THE PRINCETON FLOATING MULTIPOLE MACHINE. File, J.; Bonanos, P. (Princeton Univ., NJ). pp 354-360 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The Princeton Floating Multipole Machine, FM-1, a plasma physics experimental device, has been operating as a spherator since August 1971. The levitated poloidal field coil is a Nb_3Sn superconducting ring operable up to 375,000 ampere-turns and is sixty inches in major diameter. The coil is mounted in an isolated isochoric Dewar, and plasma physics experiments are performed with the ring levitated and stabilized by a system similar to, but improved over, those previously reported. Two such rings were built and are described including magnetic, electrical, mechanical, cryogenic and superconducting properties. (auth)

13929 12-COIL SUPERCONDUCTING BUMPY TORUS MAGNET FACILITY FOR PLASMA RESEARCH. Roth, J. R.; Holmes, A. D.; Keller, T. A.; Krawczonek, W. M. (Lewis Research Center, Cleveland). pp 361-366 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A retrospective summary is presented of the performance of the two-coil superconducting pilot rig which preceded the NASA Lewis bumpy torus. This pilot rig was operated for 550 experimental runs over a period of 7 years. The long term degradation of certain subsystems of this apparatus have implications for the design of similar facilities. The NASA Lewis bumpy torus facility consists of 12 superconducting coils, each with a 19 cm ID and capable of producing magnetic field strengths of 3.0 teslas on their axes. The magnets are equally spaced around a major circumference 1.52 m in diameter, and are mounted with the major axis of the torus vertical in a single vacuum tank 2.59 m in diameter. The design value of maximum magnetic field on the magnetic axis (3.0 T) has been reached and exceeded. A maximum magnetic field of 3.23 T has been held for a period of 60 minutes, and the coils have not gone normal. When the coils were charged up to a maximum magnetic field of 3.35 T, the coil system was driven normal without damage to the facility. (auth)

13930 CRITICAL FIELDS AND CRITICAL CURRENTS OF HIGH T_c SUPERCONDUCTORS. Saur, E. J. (Univ., Geissen, Ger.). pp 368-370 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A brief review is given of the critical data of Type-II superconductors with high T_c which might be important for future applications, namely: solid solution alloys of bcc type, β-W (A-15) type compounds, NaCl (B-1) type compounds and C-15 alloys (Laves phases), prepared with various methods in different shapes. (auth)

13931 FLUX FLOW MEMORY SWITCH. Putz, A. G.; Steingart, M.; Kramer, E. J. (Cornell Univ., Ithaca, NY). pp 442-445 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A memory switch, based on the multiple-valued voltage-current characteristic of a plastically deformed Type II superconductor, is described. Switching to the non-zero voltage ("on") state is accomplished with a current pulse sufficient to cause flux flow, which is presumed to disrupt the pin matching and/or perfection of the flux line lattice (FLL). The minimum current pulse duration to cause this switching is ~100 μs at a peak electric field of 4 μV/cm. Switching back to the zero voltage ("off") state is accomplished by sending a current pulse sufficient to heat the crystal above the critical temperature $T_c(H)$. In the experiments heating is principally at a resistive spot weld in series with the crystal and in good thermal contact with it. (auth)

13932 ENERGY CONSIDERATIONS REGARDING THE PROPAGATION OF FIELD PENETRATION ALONG TYPE-II SUPERCONDUCTOR WIRES. Walker, M. S.; Hulm, J. K. (Westinghouse Research Labs., Pittsburgh). pp 446-451 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The decay of persistent currents has been triggered in a number of Nb−25% Zr wires situated in changing longitudinal magnetic fields at 4.2°K. Under favorable conditions the decay was observed to propagate from the heater trigger through two search coils spaced along the wire. Propagation velocities were found to range from 2×10^4 to 10^6 cm/sec, exceeding the speed of sound in some instances. The heat inputs required to start propagation and propagation velocities are related to the stored energy released during the decay process. An electromagnetic propagation mechanism is postulated to explain the high propagation velocities. (auth)

13933 VELOCITY OF PROPAGATION OF FLUX JUMPS ALONG TYPE-II SUPERCONDUCTING WIRES IN AXIAL FIELDS. Bussiere, J.; LeBlanc, M. A. R. (Univ. of Ottawa). pp 452-456 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Measurements of the propagation of magnetic instabilities or flux jumps are presented for wires of NbTi, NbZr, and pure Nb. The velocities range between 10^5 and 10^6 cm/s for the alloys and 10^4 and 10^5 cm/s for the pure Nb. For a given material the velocity is seen to increase as the change in magnetization $\Delta < 4\pi M >$ associated with the flux jump increases. A comparison between the velocities of the different materials indicates that the velocity also increases with the normal state resistivity. Qualitative arguments are presented pointing towards a radial diffusion type process together with an electromagnetic coupling between adjacent regions as the basis of the mechanism causing the propagation. (auth)

13934 MAGNETIC LOSSES IN A 500 kOe/s PULSED SUPERCONDUCTING SOLENOID. Haller, T. R. (Intermagnetics General Corp., Guiderland, NY). 457-460 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

In order to meet demands for field-cycling NMR studies, a 3.5 cm bore NbTi solenoid has been developed having a field uniformity of 1 part in 10^4 in a 1 cm DSV. This solenoid has been cycled many times at up to 26 kOe peak to peak at 10 Hz with no evidence of normalcy. Frequencies of up to 108 Hz have been successfully achieved at reduced field strengths. The design utilizes single core copper stabilized superconductor with interlayer cooling channels. Surface heat flux is thereby kept below nucleate boiling limits. Testing was performed by discharging a capacitor bank through the coil and observing the decay of the resultant sinusoidal voltage waveform from which magnet losses could be calculated. By varying the capacitance and voltage, data were obtained for a variety of frequencies and field strengths. Measured losses were found to be in general agreement with those predicted by theory

when superconductor hysteresis, copper eddy current, and copper transport current mechanisms are considered. (auth)

13935 COUPLING IN SUPERCONDUCTING BRAIDS AND CABLES. Gilbert, W.; Voelker, F.; Acker, R.; Kaugerta, J. (Univ. of California, Berkeley). pp 486-490 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

In pulsed, low loss, superconducting magnets one often uses high current cables or braids composed of a number of composite wires, each containing hundreds of fine NbTi filaments. Cables in the 500 to 3000 ampere range, combining 50 to 150 wires, with filament diameters of 5.6 to 11μ have been tested for inter-wire coupling by measuring the pulse losses in solenoid magnets wound from various braids and cables. Losses were electrically determined with a newly developed digital-multiplier-integrator system. The measured dependence of the couplings upon applied magnetic field changes and cable geometry is in reasonable agreement with our intra-cable and intra-braid coupling theories. The losses in several magnets do not double their superconducting hysteretic zero B cyclic loss until the B exceeds 100 kG sec^{-1}. (auth)

13936 NEW SUPERCONDUCTING COMPOSITE WITH LOW HYSTERESIS LOSS. Popley, R. A. (Imperial Metal Industries Ltd., Birmingham, Eng.); Sambrook, D. J.; Walters, C. R.; Wilson, M. N. pp 516-517 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A new way of making filamentary composites for use in pulsed magnets is described. It is hoped that the new technique will enable composites to be made which contain many more filaments than previously and yet have a low hysteresis loss and are stable. A special kind of extrusion canister forms the basis of the technique. (auth)

13937 OPERATING CHARACTERISTICS OF CYLINDRICAL THIN FILM WEAK LINK CIRCUITS USED AS THE SENSING ELEMENT IN ULTRA-SENSITIVE MAGNETOMETER SYSTEMS. Nisenoff, M. (Stanford Research Inst., Menlo Park, CA). pp 525-534 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The present state of development of thin film superconducting weak link devices is reviewed. An equivalent circuit is presented for a weak link device, and an analysis is carried out describing the operation of a weak link device coupled to a LC resonant circuit using simple ac circuit theory. Expressions are obtained for the magnitude of the magnetic field dependent component of the rf impedance of the coupled circuit as a function of circuit parameters. Criteria are presented for the observation of the field dependent rf impedance as a function of circuit geometry and operation conditions. (auth)

13938 JOSEPHSON TUNNEL JUNCTIONS. Matisoo, J. (IBM T. J. Watson Research Center, Yorktown Heights, NY). pp 535-543 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The technology and electrical properties peculiar to the tunnel junction are reviewed. It is concluded that the preferred applications of the tunnel junction at the moment appear to be in situations in which an extremely well characterized device is essential, such as in the e/h measurements and for computer applications. (MHR)

13939 REVIEW OF THE PROPERTIES AND APPLICATIONS OF SUPERCONDUCTING POINT CONTACTS. Zimmerman, J. E. (Inst. of Basic Standards, Boulder, CO). pp 544-561 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Superconducting small-area ("point") contacts are easily made in a number of forms, and are used in a wide variety of devices, some of which are quite highly evolved. For many practical purposes no special contact surface preparation is required. Electrical properties are often said to be "tunnel-junction like" or "metal-bridge like," but the meaning of these terms is not clear. New evidence shows that perfectly-clean metallic contacts often exhibit all the features expected of low-capacitance tunnel junctions. Permanently-stable point-contact devices have been made by one or a combination of several techniques, but their vulnerability to electrical and other transients has led to the development of simple and effective adjusting mechanisms. Certain point contacts, with minimum possible shunt capacitance and shunt normal conductance, approach the ideal of pure Josephson current elements ($i = i_c \sin \theta$) more closely than any other type of Josephson junction, and, for this reason, appear to be the best type of junction for millimeter-wave and far-infrared applications. Paradoxically, the dc-IV characteristics of such pure Josephson elements can be very complex if they are closely coupled to external circuit elements such as microwave cavities and resonances of impurity molecules. (auth)

13940 DURABLE THIN-FILM JOSEPHSON TUNNEL JUNCTIONS. Schwidtal, K.; Finnegan, R. D. (Army Electronics Tech. and Devices Lab., Fort Monmouth, NJ). pp 562-564 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Nb/NbO_x/Pb thin-film Josephson tunnel junctions were prepared with any desired area resistivity, and with tunnel barrier layers that are reproducibly uniform, and remain so with time. Thermal cycling requires no special precautions. The normal tunnel resistance R_{NT} changes with time t of junction storage at room temperature only as $R_{NT} \propto t^{-\frac{1}{4}}$. Junction preparation and parameters determining durability are described in detail. (auth)

13941 JOSEPHSON AND GIAEVER EFFECTS WITH A SEMICONDUCTING BARRIER OF VARIABLE HEIGHT. Cardinne, P.; Manhes, B.; Renard, M. (Centre d'Etudes Cryogeniques, Sassenage, France). pp 565-569 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Josephson and Giaever effects are observed in plane junctions with evaporated semiconducting barrier (100 to 200 Å). A model using semiconductor–metal properties allows us to explain the main experimental results. The important parameters governing the general behavior are found to be the doping and the thermally excited electrons. Besides, certain results show deviation from tunneling properties of junctions with oxide barriers. (auth)

13942 MAGNETOCHEMICAL STUDIES WITH AN ULTRASENSITIVE SUPERCONDUCTING QUANTUM MAGNETOMETER. Hoenig, H. E.; Wang, R. H.; Rossman, G. R.; Mercereau, J. E. (California Inst. of Tech., Pasadena). pp 570-574 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A magnetometer utilizing quantum superconductivity as the basis for the flux sensor element was designed and used for biochemical susceptibility measurements in the temperature range from 1.5°K to 300°K. The sensitivity and reproducibility of this instrument were tested by measurements on small amounts of material of well-known susceptibilities. Using this instrument the temperature dependence of the magnetic susceptibilities of oxy- and metaquohemerythrin have been measured and for the first time their antiferromagnetic components have been unambiguously resolved. From this data the exchange coupling constants between the two high-spin iron (III) atoms in each subunit have been determined to be -77 and -134 cm^{-1} respectively. (auth)

13943 EFFECTS OF DYNAMICS IN THE FLUX SHUTTLE AND OTHER JOSEPHSON CIRCUITS AND DEVICES. Fulton, T. A. (Bell Labs., Murray Hill, NJ). pp 575-580 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The behavior of a variety of circuits employing Josephson junctions is discussed in terms of their mechanical analogs. (auth)

13944 THERMAL FLUCTUATION NOISE IN A SUPERCONDUCTING FLUX DETECTOR. Kurkijarvi, J.; Webb, W. W. (Cornell Univ., Ithaca, NY). pp 581-587 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The thermal fluctuation noise in superconducting quantum flux detectors biased at radio frequencies has been calculated using a recent theory by J. Kurkijärvi of the intrinsic fluctuations of a

superconducting ring of inductance L_s closed by a Josephson junction of critical current i_c. The spectral density at low frequencies is found to be $\langle[\delta\Phi_x(0)]^2\rangle \cong (0.5/f_{RF})\{L_s i_c^{-1}(2\pi k_B T/\Phi_0)^{1/2}(3/4\sqrt{2})^{1/2}\times[1-(\Phi_0/2\pi L i_c)^2]^{1/2}$ at temperature $k_B T$ in units of flux quanta Φ_0. For typical flux detector parameters $\langle[\delta\Phi_x(0)]^2\rangle^{1/2}/(Hz)^{1/2} \sim 2\times10^{-5}$ Φ_0. An expression for the plateau shape for the plot of detected tank circuit voltage versus drive current is also given. (auth)

13945 USE OF JOSEPHSON JUNCTIONS FOR NOISE THERMOMETRY BELOW 1 KELVIN. Soulen, R. J. Jr.; Marshak, H. (National Bureau of Standards, Washington, DC). pp 588-591 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Kamper and Zimmerman have demonstrated that a Josephson junction connected in parallel to a resistor converts the Johnson noise voltage fluctuations into frequency fluctuations, and that the variance of these frequency fluctuations is simply related to absolute temperature. In order to make accurate measurements of temperature with this device, a fast data acquisition system consisting of a frequency counter interfaced to a small computer has been developed. This thermometer has been compared to a ^{60}Co γ-ray anisotropy thermometer in the temperature region of .020 to .050 K. Preliminary results indicate agreement to within 5%. The results were used to redetermine the superconductive transition temperature of pure beryllium. The value is .0228 K, 3mK lower than reported by Falge. Since the thermometers do not depend upon any calibration or extrapolation and only on some accurately and independently determined parameters of each system, our value of T_c is probably very close to the absolute temperature of the transition. (auth)

13946 RESPONSE OF THE SELF-DRIVEN, WEAKLY CONNECTED SUPERCONDUCTING RING (ac-SQUID). Kanter, H.; Silver, A. H. (Aerospace Corp., El Segundo, CA). pp 592-596 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The response of a resonance circuit when coupled to a superconducting ring incorporating a small voltage biased Josephson junction was investigated. The Josephson frequency, ω_0, was varied over several multiples of the resonance, ω_r, (30 MHz). For $\omega_0 = \omega_r$ and small $\beta = 2eLI_c/\hbar$, the tank voltage amplitude varied proportionately to critical current but saturated for $\beta \sim 1$. At $\omega_0 = 2\omega_r$ and $\beta \sim 1$ parametric self-excitation was observed with amplitude saturation for large I_c similar to that observed for $\omega_0 = \omega_r$. Application of an external signal, v $\sin\omega_r t$, showed Fourier components of currents nearly described by pairs of Bessel function amplitudes as expected from modulation of the quantum phase. For β small enough to avoid parametric excitation the response at $\omega_0 = 2\omega_r$ represented parametric amplification in the degenerate negative resistance mode. Since Josephson oscillations have been shown to occur well into the far infrared region, the latter effect may have considerable practical potential for self-pumped parametric amplification of weak millimeter and submillimeter signals. (auth)

13947 EQUIVALENT CIRCUITS FOR SMALL DAYEM BRIDGES. Gregers-Hansen, P. E.; Hendricks, E.; Levinsen, M. T.; Pedersen, G. F. (Univ. of Copenhagen). pp 597-602 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

An experimental investigation of small Dayem bridges (superconducting thin-film microbridges) prepared by a new method is reported. The I–V characteristics of these bridges were measured at many different temperatures and in varying microwave fields. The experimental results are compared with analog computations on several simple equivalent circuits. The small Dayem bridges are found to be fairly well described by an equivalent circuit consisting of a resistor in parallel with a device determined by the two Josephson equations and driven by a constant current source. Deviations, however, occur. Near the transition temperature the substitution of a voltage source in series with a self-inductance can explain many of the observed deviations. At lower temperatures both a capacitor and a self-inductance must be added to the simple equivalent circuit to obtain qualitative agreement with experiment. Several of the experimentally observed deviations from analog calculations on the simple circuit cannot be explained by addition of lumped impedance elements, indicating the need for an approach based on more fundamental concepts. (auth)

13948 NUMERICAL CALCULATIONS OF MIXING WITH SUPERCONDUCTING WEAK LINKS. Auracher, F.; Van Duzer, T. (Univ. of California, Berkeley). pp 603-607 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Extensive numerical calculations are reported on the mixing properties of superconducting weak links driven by two RF current sources at frequencies ω_1 (local oscillator) and ω_2 (signal) and biased with a dc current. For small signal amplitudes (I_2), the IF (intermediate frequency) voltage across the weak link is calculated as a function of the bias current, the local-oscillator amplitude I_1, and the dimensionless parameter $K_1 = \hbar\omega_1/2eI_mR$, where I_m is the maximum dc Josephson current. Two modes of operation are found depending on the proximity of ω_1 and ω_2 and the relative values of I_1 and I_2, as was observed by Grimes and Shapiro. For $\omega_{IF} \gtrsim \omega_1/10$ and not-too-small signal amplitudes, additional steps occur in the dc I–V characteristics and a nonlinear IF response was found. When $\omega_1 = \omega_2$ and $I_2 \ll I_1$ the response is linear in a certain range of bias current and conversion gain is possible for small values of K_1. For this linear mode of operation it is shown that the IF response can be calculated from pairs of I–V characteristics with $I_2 = 0$ and two different values of local oscillator current. (auth)

13949 OBSERVATION OF MICROWAVE INDUCED STEPS IN THE I–V CHARACTERISTIC OF Mo–Re DAYEM BRIDGES AT TEMPERATURES ABOVE 12°K. Janocko, M. A.; Gavaler, J. R.; Jones, C. K. (Westinghouse Research Labs., Pittsburgh). pp 608-612 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Steps induced by 9 GHz microwave radiation were observed in the current–voltage curves of Mo–Re alloy Dayem bridges operating at temperatures up to 12.6°K. This is the first time that a definite Josephson effect has been seen at these elevated temperatures in a thin film junction of the Dayem bridge type. Thus Josephson junctions having this stable and reproducible configuration can now be used at temperatures easily and efficiently obtainable with closed cycle refrigerators. (auth)

13950 APPLICATION OF MICROSUPERCONDUCTIVITY TO HIGH FREQUENCY DETECTION. Shapiro, S. (Univ. of Rochester, NY). pp 614-620 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The use of superconducting bolometers and of Josephson effect weak links as detectors for both broad-band and narrow-band signals from microwave frequencies to the far-infrared is reviewed. Emphasis is on the basic principles and mechanisms of operation used in achieving reported speed, sensitivity and frequency response values. Superconducting thin-films operate as bolometers in either an isothermal mode, in which each element of the film is at the same temperature, or in a nonisothermal mode, in which a temperature gradient is established along the film. In the former case, with tight thermal contact to the surrounding liquid helium bath, time constants of 20 ns were achieved at NEP values of about 10^{-9} W/$\sqrt{Hz}$. When designed with looser thermal contact to the bath, i.e., time constants of about 1 s, similar bolometers have achieved NEP values of about 10^{-13} W/$\sqrt{Hz}$. Nonthermal detectors employing the ac Josephson effect in superconducting weak links operate in several video modes for either broad-band or narrow-band signals: detection via a change in a junction's maximum zero-voltage current, or via modulation of an rf-induced step, or via a change in amplitude of a cavity-induced step. Heterodyne detection mechanisms include direct mixing of two rf input signals, mixing of harmonics of one rf input against another rf input, and self-mixing in which Josephson currents themselves serve as local oscillator to mix with an incident signal. Limiting values so far achieved include estimates of NEP of about 5×10^{-15} W/$\sqrt{Hz}$, speed of response better than 10 ns, and frequency response to 78 μ. (auth)

13951 PRECISE ELECTRICAL MEASUREMENTS AT LOW TEMPERATURE. Sullivan, D. B. (Inst. for Basic Standards, Boulder, CO). pp 631-639 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The application of low temperature phenomena, particularly superconductivity, to electrical metrology is reviewed. The re-

view includes a number of recent developments which involve measurement systems based on the quantum of magnetic flux as well as adaptations of classical concepts to low temperature devices. Quantities considered include radio frequency current, infrared frequency, and direct current and voltage. Concepts for secondary emf standards are also discussed. (auth)

13952 ADVANCES IN SUPERCONDUCTING INSTRUMENT SYSTEMS. Goree, W. S. (Develco Inc., Mountain View, CA). pp 640-648 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland USA (1 May 1972). See CONF-720513-.

Technically advanced superconducting instrument systems are described which use presently available superconducting materials, skills, and techniques to provide to a wide variety of applications a reliable, high performance, easy-to-use capability. In the design of these instruments emphasis has been placed on providing practical cost effective solutions to specific user problems. The following topics are discussed: superconducting magnetic shields, superconducting magnetometer, magnetometer applications, flux transformers, gradiometers, magnetometer-shield systems, and cryostats. (MHR)

13953 PHASE STABILIZATION OF SUPERCONDUCTING HELICAL ACCELERATING STRUCTURES. Dick, G. J.; Shepard, K. W. (California Inst. of Tech., Pasadena). pp 649-652 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Measurements on superconducting helical resonators in the 30 to 60 MHz region show mechanical deformation causing eigenfrequency shifts a factor of 10^5 greater than the intrinsic bandwidth due to radiation pressure at operating field levels, and shifts of 10^2 bandwidths due to ambient vibration. In order to operate a series of resonators as an accelerating structure, each resonator must be phase-locked to an external clock. Control circuitry was developed using RF feedback which locks the amplitude and phase of the voltage in a resonator at high power levels to that of a reference oscillator despite large changes in the eigenfrequency. Additionally, methods for increasing the mechanical stability of a superconducting helix with dielectric support were developed. A sapphire support structure was successfully tested in a superconducting resonator at high field levels without causing significant increases in power loss. (auth)

13954 INVESTIGATION OF NIOBIUM DEFLECTING CAVITY MODELS FOR USE IN A SUPERCONDUCTING RF PARTICLE SEPARATOR. Bauer, W. (Univ., Karlsruhe, Ger.); Citron, A.; Dammertz, G.; Eschelbacher, H. C.; Juengst, W.; Lengeler, H.; Miller, H.; Rathgeber, E.; Diepers, H. pp 653-657 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A superconducting RF particle separator will be constructed for use with the CERN 300-GeV proton synchrotron. As an intermediate step towards this project a prototype separator will be tested in a beam from the 28-GeV machine at CERN. The main features of this test-separator are described. A summary of recent results of Q- and peak field measurements on small test cavities at 2855 MHz is given. The highest Q-value obtained so far in a deflecting cavity was $1.4 \cdot 10^9$, the highest deflecting field was 3.0 MV/m corresponding to a peak magnetic field of 470 G. Some thoughts and calculations on the RF joint problem are reported. (auth)

13955 VARIATION OF RF-SURFACE RESISTANCE WITH FIELD STRENGTH IN ANODIZED NIOBIUM CAVITIES. Kneisel, P.; Stoltz, O.; Halbritter, J. (Kernforschungszentrum, Karlsruhe, Germany). pp 657-661 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Superconducting Nb cavities of low residual losses show unusual dependencies of the losses on RF field level. By anodizing Nb in a special way one has achieved in a S-band cavity residual losses $R_{res} < 2 \cdot 10^{-9}\Omega$, the lowest measured at these frequencies till now, and breakdown fields of about 400 Oe. Together with these small residual losses the surface resistance becomes strongly RF field strength dependent due to unknown mechanisms. To clear up these mechanisms, the R(H)-dependence in different modes was studied between 2 and 4 GHz at different temperatures. As a result, the low field structures in R(H) belong to a surface sheath of Nb and are very sensitive, e.g. can be changed by electron impact. The measurement at high RF field strength shows sudden changes of R(H) and a breakdown field depending like $[1-(T/T_c)^2]$ on temperature in modes with negligible electron loading. (auth)

13956 RF BREAKDOWN OF SUPERCONDUCTING CAVITIES. Halbritter, J. (Kernforschungszentrum, Karlsruhe, Ger.). pp 662-666 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Whereas in normalconducting cavities the rf field strengths are limited by discharges due to high electric fields, as yet in superconducting cavities the actual limitation is an rf breakdown related to the magnetic field, i.e. due to the dissipation of shielding currents. This new type of breakdown is due to the rf absorption strongly increasing with temperature, especially near the phase transition from the superconducting to the normalconducting state. Like in all thermodynamic phase transitions of first order, the breakdown is initiated by nucleation of normalconducting regions. The nucleation is eased by surface inhomogeneities or by local heating, e.g. due to the impact of charged particles. Because the dimension of the normal regions must be of the order of the coherence length ξ, it will be more difficult to reach breakdown fields H_c of about $H_c(T)$ in materials with short coherence length, e.g. in Nb, than e.g. in In, Sn, Pb. The proposed model explains the observed dependence of H_c on material parameters or temperature, which shows that the thermal conductivity does not define H_c. (auth)

13957 SOME SUPERCONDUCTIVE THIN FILM DEVICES FOR RADIO AND MICROWAVE FREQUENCIES. Passow, C. A.; Newhouse, V. L.; Gunshor, R. L. (Purdue Univ., Lafayette, IN). pp 673-678 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

It is shown that the low ohmic losses of superconductors make possible the construction of radio and microwave devices which are one or more orders of magnitude smaller than their room temperature counterparts, and exhibit improved performance. The possibility of miniaturization permits the use of thin film techniques with the attendant economies of fabrication by evaporation and photo-etching. Three thin film devices are described; a nondispersive ultracompact delay line, a dispersive line intended for pulse compression, and a tuneable line which uses the kinetic inductance effect. The advantages and disadvantages of superconductors vis a vis room temperature microwave acoustic techniques are discussed. (auth)

13958 SUPERCONDUCTING TIME-VARIANT FILTERING SYSTEM. Arndt, G. D. (Manned Spacecraft Center, Houston, TX). Eggleston, T. W.; Alworth, C. W.; Haden, C. R. pp 679-683 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

The development of a laboratory test facility for studying the tracking capabilities of a superconducting time-varying filter system is described. A closed-cycle helium refrigerator provides cooling to the cavity, which is lead-plated, and to the semiconductor. (MHR)

13959 SUPERCONDUCTING GRAVITATIONAL DETECTOR. Dick, G. J.; Yen, H. C. (California Inst. of Tech., Pasadena). pp 684-686 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A technique to detect very small displacements using superconducting resonators and existing semiconductor technology was analyzed and is being developed. This technique obtains a sensitivity to fractional changes in frequency of 10^{-14} at a modulation frequency of 1 kHz with a time constant of one second. For a resonator with a characteristic size of 10μ this gives a distance sensitivity of 10^{-17} cm. The sensitivity of the method is limited by noise in the semiconducting phase detectors presently available. Properties required of the superconducting resonators are not stringent; Q's and field levels are well within the state of the art. Such a detector is a parametric transducer. Since it does not introduce mechanical losses, it can be used with strain multiplication techniques to give very good sensitivity to impulsive vibrations in either a room temperature or a cryogenically cooled resonant gravitational antenna. (auth)

13960 RF SURFACE IMPEDANCE MEASUREMENTS ON SUPERCONDUCTING NIOBIUM FILMS. SooHoo, W. J.; Coren, R. L. (Drexel Univ., Philadelphia). pp 687-690 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Nb films, 100 A to 700 A thick, were evaporated at 10^{-6} torr onto unheated glass substrates. Using a 10 GHz bridge the complex reflection coefficient was measured at 4.2 K as a magnetic field varied normal to the film. H_{c2} is 7 to 9 kOe; magnetic hysteresis effects are observed. The data are analyzed using an oscillating fluxoid model. At this frequency direct pinning effects can be neglected. The field variations are obtained for η, the viscosity coefficient and M the mass of the fluxoid bundle. The values found are: $\eta \simeq 10^{-13}$ joule sec/m^3 and $M \simeq 5(10)^4$ electrons/m. (auth)

13961 SUPERCONDUCTOR MASER: A CALCULATION OF THE GAIN FROM THE TWO-LEVEL MODEL AND THE BCS THEORY AND SOME NEW EXPERIMENTAL RESULTS. Mathews, W. N., Jr.; Gregory, W. D.; Leopold, G. L.; Bostock, J.; George, J. (Georgetown Univ., Washington, DC). pp 691-695 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A theory for the gain due to stimulated emission of radiation at the gap frequency in superconductors is presented. Within the context of first order time-dependent perturbation theory, the two-level model recently developed by Fife and Gygax, and the BCS microscopic theory of superconductivity, it is found that positive gain is possible, both near absolute zero and very near the critical temperature. Recent experiments furnish further evidence for the existence of radiative emission from appropriately formed N-S point contact tunnel junctions. (auth)

13962 QUANTUM MECHANICAL MEASUREMENT OF RF ATTENUATION. Kamper, R. A.; Simmonds, M. B.; Adair, R. T.; Hoer, C. A. (Inst. for Basic Standards, Boulder, CO). pp 696-701 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A broadband superconducting quantum interference device (SQUID), operating at a frequency of 9 GHz, was used as a sensor of current at lower radio frequencies. The periodic nature of the response of the SQUID enabled us to measure variations in rf attenuation directly. The results of such a measurement were in agreement with the NBS Calibration Service to within ±0.004 dB over a dynamic range of 40 dB. Other applications of this SQUID to rf measurements are also discussed. (MHR)

13963 RADIATION GENERATION AND DETECTION CHARACTERISTICS OF ARRAYS OF POINT CONTACT JOSEPHSON JUNCTIONS. Repici, D. J.; Leopold, L.; Gregory, W. D.; Behravseh, M.; Thompson, T. (Georgetown Univ., Washington, DC). pp 701-706 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Ten arrays of 180 Josephson junction point contacts each of the type first studied by Clark have been investigated. The arrays were composed of an ordered 10 × 10 matrix of tin spheres 1.1 mm in diameter. The radiation generation and detection capabilities of the arrays were studied using a resonant structure formed by placing the arrays between two moveable parallel mirrors. In some cases, one of the mirrors was external to the cryostat, thus delivering the radiation out of the dewar. Other experiments were performed by shining 97 GHz klystron radiation on the array. The results indicate a rich spectrum of radiative frequencies, from the mm to hundreds of microns wavelength region, with some predominance at 1.2 mm and 202 microns. A new estimate of the power developed by the arrays (40 nanowatts) is in agreement with a previous estimate of Clark. (auth)

13964 WEAKLY SUPERCONDUCTING, THIN-FILM STRUCTURES AS RADIATION DETECTORS. Kirschman, R. K. (California Inst. of Tech., Pasadena). pp 707-709 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

A thin-film superconducting structure is described, which—on the basis of low-frequency measurements—shows promise as a microwave and infrared detector. (auth)

13965 JOSEPHSON JUNCTION ONE MULTIMETER MICROWAVE SOURCE: COUPLING OUTSIDE A DEWAR. Ulrich, B. T.; Kluth, E. O. (Univ. of Texas, Austin). pp 709-711 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Microwave radiation at short millimeter wavelengths from a Josephson junction has been transmitted outside a dewar for use in a room temperature environment. The experiments that demonstrate the utility of a Josephson junction as a millimeter microwave source are described. A single point contact superconducting junction was used as a microwave emitter at discrete wavelengths between 1.1 mm and 2.6 mm. These wavelengths were determined by resonances of a cavity tightly coupled to the Josephson junction, biased to a voltage corresponding to the cavity frequency. The emitting Josephson junction also was used as a detector of its own radiation, and gave a signal-to-noise ratio of 10^3/NHz. The Josephson junction microwave source is expected to find applications in laboratory microwave measurements such as the measurement of transmission and reflectance of materials at short millimeter wavelengths. (MHR)

13966 DIRECT DEMONSTRATION OF JOSEPHSON FREQUENCY CONVERSION. Longacre, A. Jr. (Univ. of Rochester, NY). pp 712-715 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Josephson frequency conversion, a mode of operating the Josephson junction in which an input signal is up or down-converted by mixing with the ac Josephson currents, has been demonstrated and studied in superconducting point-contact junctions at microwave frequencies. In particular, down-conversion from 24 GHz to 9.3 GHZ was directly achieved, and evidence of conversion from 640 GHz to 20 GHz was also obtained. An analog simulation of the experiments has assisted in understanding these ac processes in point-contact junctions. (auth)

13967 MILLIMETER AND SUBMILLIMETER WAVE RADIATION GENERATED BY A JOSEPHSON JUNCTION. Elsley, R. K.; Sievers, A. J. (Cornell Univ., Ithaca, NY). pp 716-718 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Up to 10^{-9}W of electromagnetic radiation emitted by a point contact Josephson junction in the frequency range of 2 cm^{-1} to 13 cm^{-1} was generated and remotely analyzed. (auth)

13968 MIXING WITH GAIN IN JOSEPHSON JUNCTIONS. Ulrich, B. T. (Univ. of Texas, Austin); Lee, T. pp 718-724 of Proceedings of the 1972 Applied Superconductivity Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1972).

From applied superconductivity conference; Annapolis, Maryland, USA (1 May 1972). See CONF-720513-.

Frequency conversion efficiency is calculated analytically for a resistively shunted Josephson junction in which the ac Josephson oscillation serves as local oscillator. Effects due to frequency dependent impedances are treated explicitly. Conversion efficiency greater than one can occur; i.e., mixing with gain is possible in a Josephson junction OScillator-Mixer-preamplifiER (OSMER). (auth)

13969 SUPERCONDUCTING SOLENOID FROM DEFORMED ALLOYS WITH A FIELD UP TO 122 K-OERSTEDS. Lazarev, B. G.; Lazareva, L. S.; Goridov, S. I.; Golik, V. R. (Physical Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 2, 443-444(1973). (In Russian).

A nonstabilized copper-plated Nb–60% Ti alloy wire was employed in winding a laboratory solenoid with a field intensity of 122 kOe. Its critical current was measured as a function of the temperature from 1.6 to 5.2°K, and compared with similar data for a ternary alloy of Nb–Zr–Ti. The solenoid consisted of three coaxial sections fed in parallel; their dimensions and numbers of turns are tabulated. (KSW)

13970 OPTIMAL FORM OF A SUPERCONDUCTING SOLENOID. Grinberg, G. K.; Laumanis, I. Ya.; Lietuvietis, O. I. Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 82-85(1973). (In Russian).

The optimal form of a short superconducting solenoid is calculated enabling to reduce the number of windings by several tens of % in comparison to the best variants of ordinary solenoids, their magnetic field strength being equal. (auth)

13971 SUPERCONDUCTING JOINTS. Dolezal, I.; Jelinek, J. Cesk. Cas. Fys.; No. 3, 286-290(1973). (In Czech).

The requirements on time stability of the magnetic field of solenoids for NMR lead to the necessity of connecting superconductors having a contract resistance of the joints of 10^{-11} Ω. A number of methods (electron beam, laser, superconducting solder, ultrasound, electric resistance welding) were tried. Best results and a good reproducibility were obtained by making the joints by means of explosive pressing. The preparation of superconductors and the technology of joints are described. The parameters are comparable with the critical parameters of the superconductor. The contact resistance of the joints measured by means of magnetic field decay of the loop in the persistent mode is lower than 10^{-12} Ω. (auth)

13972 MATCHING A SYSTEM OF RIBBON-FILAMENT TUNNEL SUPERCONDUCTING CONTACTS WITH FREE SPACE. Butorin, V. M.; Dmitriev, V. M.; Krivosheev, E. F.; Pavlyuk, V. A.; Tret'yakov, O. A. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 9, 1501-1507(Sep 1972).

Translated from Radiotekh. Elektron.; 17: No. 9, 1885-1892 (Sep 1972).

The problem of exciting a plane electromagnetic wave of a periodic system of tunnel contacts, each of which is a superconducting band line of finite length, was solved. The condition of matching the examined system with free space was obtained and its transmission band and field amplitude inside the contact during resonance were determined. (auth)

13973 PROPERTIES OF A SUPERCONDUCTING POINT CONTACT CONNECTED TO A RESONATOR. Likharev, K. K.; Semenov, V. K. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 9, 1586-1589(Sep 1972).

Translated from Radiotekh. Elektron.; 17: No. 9, 1983-1985 (Sep 1972).

The characteristics of the Josephson generation of a contact in the Aslamazov–Larkin model were investigated by connecting it to a resonator. (MHR)

13974 EXPERIMENTS USING A SUPERCONDUCTING POINT-CONTACT HARMONIC MIXER NEAR 1 THz. Blaney, T. G.; Knight, D. J. E. (National Physical Lab., Teddington, Eng.). J. Phys., D (London); 6: No. 8, 936-952(21 May 1973).

Experiments are described in which simple and relatively reliable point-contact Josephson junctions were used to generate and mix harmonics (up to the 50th) of microwave klystron frequencies with emissions from a hydrogen cyanide laser operating at 891 GHz. Data are presented illustrating the variation of the intermediate frequency signal with DC bias current through the junction and incident radiation power levels, and the results compared, where possible, with a simple qualitative theory of Josephson mixing. Details are also given of experiments in which such a mixer was used to phase-lock a klystron to the laser, enabling the laser frequency to be accurately and continuously monitored. (auth)

13975 SUPERCONDUCTING MAGNETS. Hancox, R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Atom (London); No. 199, 113-117(May 1973).

An introduction to the subject of superconductivity is followed by an outline of its application to superconducting magnets. Among matters discussed are sudden transitions, use of multiple filaments, and negligible current decay. (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 12934, 14098, and 14251.

13976 (AD-746461) AUTOMATIC COMPUTATION OF IMPORTANCE SAMPLING FUNCTIONS FOR MONTE CARLO TRANSPORT CODES: PHASE III. Final Report. Kalos, M. H.; Steinberg, H.; Troubetzkoy, E. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Jun 1972. Contract DASA01-71-C-0028. 133p. (MR-7017; DNA-2890-F). NTIS.

The report describes the development and coding effort for constructing a computer program for the generation of biasing functions needed for the Monte Carlo solution of radiation penetration problems. Included is an analysis of technical difficulties that arose in the course of the development, and a description of possible approaches to bypass these problems. (auth)

13977 (COO-3058-34, pp 36-42) FAST AND INTERMEDIATE NEUTRON SPECTRUM MEASUREMENTS IN A BULK SODIUM ASSEMBLY. Mallen, A. N.; Kaushal, N. N.; Malaviya, B. K.; Gaerttner, E. R. 1973.

In linear accelerator project.

13978 (WAPD-TM-949) BE27: A TWO-GROUP X-Y GEOMETRY TRANSPORT PROGRAM FOR DEEP PENETRATING HOMOGENEOUS MEDIA. Fischer, R. B.; Gelbard, E. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar 1973. Contract AT-11-1-Gen-14. 43p. Dep. NTIS $4.25.

The program BE27 written in FORTRAN IV for the CDC 6600 solves the two-group x-y geometry transport equation for deep penetration homogeneous medium problems using Green functions obtained from a spherical harmonics approximation. (JFP)

13979 MACK: A PROGRAM TO CALCULATE NEUTRON ENERGY RELEASE PARAMETERS AND MULTIGROUP NEUTRON REACTIONS CROSS SECTIONS FROM ENDF/B. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 129-130(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13980 MEASUREMENT AND ANALYSIS OF FAST-NEUTRON SPECTRA IN SODIUM. Mallen, A. N.; Kaushal, N. N.; Malaviya, B. K.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Amer. Nucl. Soc.; 16: 304-305(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13981 ANALYSIS AND INTERPRETATION OF ANISOTROPIC SPECTRUM MEASUREMENTS IN DEPLETED URANIUM. Becker, M.; Gaerttner, E. R.; Ginsberg, A.; Kaushal, N. N.; Malaviya, B. K. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Amer. Nucl. Soc.; 16: 305-306(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13982 NEUTRON SPECTRA IN AN EXPONENTIAL DEPLETED-URANIUM PILE. Yule, T. J.; Zolotar, B. A.; Bennett, E. F.; Olson, I. K. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 306-307(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13983 EXACT PERTURBATION OF NEUTRON CROSS SECTIONS BY CORRELATED SAMPLING: SAMCEP CODE. Steinberg, H. A. (Mathematical Applications Group, Inc., Elmsford, NY). Trans. Amer. Nucl. Soc.; 16: 344-345(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13984 CROSS-SECTION SENSITIVITY ANALYSIS FOR DISCRETE ORDINATES CALCULATIONS. Bartine, D. E.; Oblow, E. M.; Mynatt, F. R. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 345-346(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13985 CALCULATIONAL ANALYSIS OF NEUTRON AND GAMMA-RAY TRANSPORT EXPERIMENTS IN CARBON. Cramer, S. N.; Oblow, E. M. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 349-350(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13986 TREATMENT OF HYDROGEN SCATTERING IN MULTIGROUP S_N TRANSPORT CALCULATIONS. Timmons, D. H. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 16: 350-351(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

13987 ANALYTICAL TREATMENT OF TIME- AND SPACE-DEPENDENT ASYMPTOTIC BEHAVIOUR OF SLOWING DOWN NEUTRON. Yamamura, Y. (Okayama Coll. of Science, Japan); Kitazoe, Y.; Sekiya, T. J. Nucl. Energy; 27: No. 5, 303-315 (May 1973).

Asymptotic aspects of space- and time-dependent slowing down of a pulsed neutron are analytically studied, based on the time-dependent diffusion equation. The calculations are mainly concerned with the flux distribution ψ (r,u,t) and the spatially dependent most probable slowing down time $t_{max}(r,u)$. The analytic solution for $\psi(r,u,t)$ indicates that its spatial dependence is determined only by the time-dependent neutron age τ (u,t), while $t_{max}(r,u)$ is shown to be dominantly influenced by the stationary neutron age $\tau_s(u)$. From these analyses are obtained the following relations: (a) When $t = t_s \equiv \langle t \rangle_0 \{1 - \xi/(\xi + 4)(\xi + 2)\}$, $\tau(u,t)$ coincides with $\tau_s(u)$, which implies that the spatial dependence of $\nu(r,u,t)$ at that time is analogous to that of the stationary neutron distribution, where $\langle t \rangle_0$ is the first time moment; (b) The most probable slowing down time $t_{max}(r,u)$ at $r = \sqrt{\langle r^2 \rangle}$ (standard notation) becomes equal to the most probable slowing down time t_m of the spatially independent distribution $\psi(u,t)$. The cross sections employed here are assumed to be constant, but different cross-sections for the source neutrons are allowed. (auth)

13988 THERMAL NEUTRON TRANSPORT NEAR A MODERATOR DISCONTINUITY USING THE METHOD OF WEIGHTED RESIDUALS. 3. Temperature Discontinuities in Graphite and Light Water. Beynon, T. D.; Moon, J. R. (Univ. of Birmingham, Eng.). J. Phys., D (London); 6: No. 8, 953-965(21 May 1973).

A detailed analysis is made of the spatial variation of the effective thermal neutron temperature near temperature discontinuities in large volumes of graphite and light water. For graphite comparisons are made with recent measurements by Day (J. Nucl. Energy; 21: 713-32 (1967)). It is seen that it is important that proper consideration be made for the gradient of the epithermal flux. For water a number of predictions are made for both poisoned and unpoisoned systems and some doubt is cast on the feasibility of such measurements for determining the accuracy different scattering kernels for light water. It is demonstrated, for both graphite and light water, that additional information can be obtained by extracting neutron beams at angles other than perpendicular to the axis of the system. (auth)

13989 FUNCTIONAL-ANALYTIC CONCEPTS AND STRUCTURES OF NEUTRON TRANSPORT THEORY. Volume II. Ribaric, M. Ljubljana, Yugoslovia; Slovene Academy of Sciences and Arts and University of Ljubljana (1973). 444p.

This volume contains appendices for the material in volume I. There are explanatory comments, definitions, and proofs of theorems and lemmas. An extensive list of 670 references is given. Finally, there appears a summary (with 1 figure) of the work in Slovenian. (RWR)

13990 FUNCTIONAL-ANALYTIC CONCEPTS AND STRUCTURES OF NEUTRON TRANSPORT THEORY. Volume I. Ribaric, M. Ljubljana, Yugoslovia; Slovene Academy of Sciences and Arts and University of Ljubljana (1973). 695p.

Simple physical associations for various functional-analytic concepts are offered. A fair number of examples of the kind of intuitive physical reasoning that can be analyzed, systematized, and formalized by using functional-analytic methods are also presented. After an introductory chapter the material is discussed in twenty-two additional chapters arranged in five parts entitled reflection properties of a single body; reflection properties of a body composed of N parts; measurement, conceptual genesis, and experimental determinability of neutron distributions and of the reflection properties; computational aspects of determining the properties of UT_K from the properties of its parts T_κ by using the basic equation $(I - A_\mu)i_u = i_- + s$; and special topics. Chapters in the special topics part are devoted to the following subjects: transport-theory approximation to the linear theory of Parts I and II; state of a compound body UT_K and some associated concepts; nonlinear reflection properties; invariant imbedding, transmission operator-matrix, and a relationship between a black-box theory and the corresponding field theory; and the role of mathematical models in natural science. (14 figures, 3 tables) (RWR)

13991 NONLINEAR NEUTRON TRANSPORT EQUATIONS. Pao, C. V. (North Carolina State Univ., Raleigh). J. Math. Anal. Appl.; 42: No. 3, 578-593(Jun 1973).

A class of time-dependent neutron transport equations is investigated in which the total and differential scattering cross sections are nonlinear functions of neutron density function. Sufficient conditions on the nonlinear cross sections are given to insure the existence, uniqueness, and asymptotic stability of a solution in one-, two-, or three-dimensional space domains under various boundary and initial conditions. The approach to the problem is based on abstract analysis on nonlinear evolution equations which are closely related to nonlinear semigroup theory. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 13790, 14027, 14061, and 14121.

13992 (JINR-P2-7089) ELASTIC p-^{3}He SCATTERING IN GLAUBER THEORY WITH SPIN. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 10p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Spin effects in elastic p-^{3}He scattering at T_p = 600 MeV are studied in the Glauber approximation. The amplitude F may be written as a function of the scalar amplitudes of the N-N scattering. The calculations of the differential cross section indicate that spin effects give significant contribution to the differential cross section at large momentum transfers. The curve for the $d\delta/d\Omega$ calculated in the frame of the "spinless" Glauber approximation is compared with the curve for differential cross sections with the spin dependence of N-N amplitudes included for the different density distributions of nucleons in the nuclear ^{3}He. The inclusion of the spin dependence of the N-N amplitudes succeeds in describing the experimental data of $d\delta/d\Omega$. Proton polarization is very sensitive to the form of the nuclear density distribution at large momentum transfers $-t > 0.5$ (GeV/c^2). (auth)

13993 (SUNI-23, pp 15-16) POLARIZATIONS IN n-p SCATTERING AT 16 AND 22 MeV. Jones, D. T. L.; Brooks, F. D. 1972.

13994 (SUNI-23, p 17) CROSS SECTIONS FOR THE D(n,2n) REACTION AT 8 TO 22 MeV. Pauletta, G.; Brooks, F. D. 1972.

13995 FINAL-STATE INTERACTION BETWEEN THE Λ^0-HYPERON AND RESIDUAL NUCLEUS R_3 IN THE REACTION $K^- + {}^4He \rightarrow \pi + \Lambda^0 + R_3$. I. Single-channel Calculation. Iwamura, Y. (Science Univ. of Tokyo). Progr. Theor. Phys. (Kyoto); 49: No. 2, 507-523(Feb 1973).

For the reaction $K^- + {}^4He \rightarrow \pi + \Lambda^0 + R_3$ (residual nucleus), the investigation of the final Λ^0-R_3 interaction and its spin-dependence is performed in the framework of the single-channel (i.e., without the Σ-A conversion) Omnès equation whose Born term is given by the impulse approximation. The calculation is carried out for the nuclear capture of K^- meson at rest from both the 1S and 2P atomic states. It turns out that the effect of singlet Λ^0-R_3 rescattering has considerable influence on the pion momentum distributions, while the triplet one is small. In the theory used, the refinement is performed so that the parameter-search may be carried out over all. (auth)

13996 VECTOR AND TENSOR ANALYSING POWERS IN THE SCATTERING OF 30-MeV POLARIZED DEUTERONS BY PROTONS. Fiore, A.; Nguyen Van Sen; Perrin, G.; Darves-Blanc, R.; Gondrand, J. C.; Mueller, H. (Institut des Sciences Nucleaires, Grenoble, France). Lett. Nuovo Cim.; 7: No. 7, 235-236(16 Jun 1973).

Measurements of the deuteron vector and tensor analyzing powers in the H(d,d) scattering at 30 MeV are compared with theoretical curves predicted by exact three-body calculations. A good overall agreement was found. (LBS)

13997 FULLY SELF-CONSISTENT BRUECKNER-HARTREE-FOCK AND RENORMALIZED BRUECKNER-HARTREE-FOCK CALCULATION FOR ^{4}He AND ^{16}O. Kümmel, H.; Zabolitzky, J. G. (Institut für Theoretische Physik, Ruhr-Universität Bochum, West Germany). Phys. Rev. C 7: No. 2, 547-552 (Feb 1973).

Generalized Brueckner-Hartree-Fock (BHF) and renormalized BHF (RBHF) calculations of ^{4}He and ^{16}O have been performed. They are exact, including fully self-consistent single-particle energies and wave functions, except for the truncation of the expansion into oscillator states and the assumption of spherical symmetry. The trends of earlier approximate calculations essentially are confirmed. (auth)

13998 CHARGE SYMMETRY AND NONLOCALITY OF THE TWO-NUCLEON INTERACTION. Arnold, L. G.; Seyler, R. G. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. C 7: No. 2, 574-589 (Feb 1973).

An analytic model-independent description of the nonlocal-Coulomb-correction effect in the two-nucleon system is given. A first-order estimate of the effect is found to be consistent with recent measurements of the two-neutron scattering length which suggest that a_{nn} is slightly less negative than a_{pp}. A zero-energy nonlocal correlation length of $0.6\hbar/m_\pi c$ is deduced from charge-symmetric models and the mean (-16.4 fm) of the measured values of a_{nn}. A larger value of the correlation length is obtained when symmetry-violating terms necessary to reconcile the ^{3}He-^{3}H binding-energy-difference discrepancy are included in the interaction. (auth)

13999 STUDY OF YAMAGUCHI-TYPE POTENTIALS WITH REPULSION IN THE $^3S_1$ EIGENCHANNEL. Pradhan, H. C.; Singh, Yogeshwar (Physics Department, McMaster University, Hamilton, Ontario, Canada). Phys. Rev. C 7: No. 2, 856-858 (Feb 1973).

It is shown that separable potentials including repulsion and tensor components with Yamaguchi form factors are unable to give a reasonable fit simultaneously to $^3S_1$ phase shifts and the following deuteron data: the binding energy, the quadrupole moment, and the electric form factor. It is also found that a good phase-shift cannot be obtained from potentials of this type if the D-state probability of the deuteron desired is higher than 4%. (auth)

14000 DEUTERON STRUCTURE AMBIGUITIES AND SMEARING EFFECTS IN INELASTIC ELECTRON-DEUTERON SCATTERING. Vary, James P. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts, 02139). Phys. Rev. C 7: No. 2, 521-530 (Feb 1973).

The freedom due to uncertainties in the off-shell nucleon-nucleon interaction is exploited by means of unitary transformations to generate a set of deuteron wave functions which differ primarily at short distances but reproduce the well-known static and dynamic properties of the deuteron. A set of transformations is introduced which offers a much wider degree of freedom in short-range correlations over those of Haftel and Tabakin. The bound-state momentum distributions, P(p), differ significantly for large p from each other and from the momentum distribution for the Reid soft-core wave function. These variations in the wave functions introduced here, while consistent with the conventional deuteron properties, generate a significant uncertainty in a model calculation of smearing effects for inelastic electron-deuteron scattering. This uncertainty increases with increasing $x=q^2/2M\nu$, the scaling variable. For these wave functions we estimate a maximum of 15% uncertainty in the smeared ratio of the neutron to proton structure functions $[W_{2n}/W_{2p}]$ at x=0.788 for a target missing mass greater than 2 GeV. Additionally, we find, in agreement with West, evidence to support the conclusion that smearing effects vanish near $\omega=1.5$. This property is observed for all the wave functions studied here. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 13997, 14067, 14093, 14121, 14137, 14144, 14145, 14152, and 14158.

14001 (JINR-P15-7128) INVESTIGATION OF THE REACTION $^{15}N(t,\alpha)^{14}C$. Abuzeid, M.; Kim Son Nam; Osetinskii, G. M.; Tyke, Ya.; Fryshchin, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Neutron Physics). 1973. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The differential cross sections for the reactions $^{15}N(t,\alpha)^{14}C$, $^{15}N(t,\alpha_1)^{14}C^*$ were measured at angles of 45° and 90° in the laboratory system in the energy range of 816 to 1620 keV by using a gas target. The angular distributions of α particles from the reaction $^{15}N(t,\alpha)^{14}C$ were measured. The total cross sections have values of 3.8 ± 0.2 mb at an energy of 1.16 MeV; these reach the value of 17.6 ± 0.5 mb at 1.45 MeV. (5 figures, 4 tables) (auth)

14002 (LA-5230-T) STUDY OF THE (π^+,p) AND (π^+,pp) REACTIONS ON SELECTED LIGHT NUCLEI. Arthur, E. D. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 239p. Dep. NTIS $7.60.

Thesis. Submitted to Univ. of Virginia, Charlottesville.

The capture in flight of positive pions on the p-shell nuclei ^{6}Li, ^{14}N, and ^{16}O with the subsequent ejection of two fast protons was studied. The measurement of the energy and angle of the two emitted protons, along with the knowledge of the pion momentum, allowed a complete determination of the final state to be made. Experimental distributions in opening angle, recoil momentum, relative momentum, and Treiman-Yang angle for low-lying states of the residual nuclei were compared with the predictions of the

pole model and the plane wave impulse approximation based on the assumption of absorption of the pion on a quasi deuteron. Agreement was found between the experimental distributions and the predictions of these models. The center-of-mass angle dependence of the cross section for events resulting from capture on ^{6}Li and ^{16}O was found to follow the $A(0.23 + \cos^2 \theta_{cm})$ dependence of the cross section for capture on a free deuteron. Excitation energy spectra from capture on ^{14}N and ^{16}O did not agree well with existing theoretical calculations. The rarer process of the capture of positive pions leading to the emission of one proton was also measured. The nuclei studied were ^{6}Li, ^{9}Be, ^{12}C, and ^{16}O. Angular distributions were obtained for ^{12}C and ^{6}Li. For ^{9}Be and ^{16}O only upper limits were obtained for the cross section since there was little contribution to the excitation spectrum of the residual nucleus above that from background. The results obtained for ^{12}C were found to be lower than previous experiments and existing theories. The dependence of the ^{6}Li cross section upon laboratory angle was found to decrease rapidly for angles less than 60° and then to become fairly constant in the measured range up to 90°. (auth)

14003 (N-72-29705) COMPUTER CODE FOR PREDICTING GAMMA PRODUCTION CROSS SECTIONS BY NEUTRON INELASTIC SCATTERING FROM LIGHT NUCLEI. Final Report. George, M. C. (Alabama A and M Univ., Normal (USA)). Jun 1972. 45p. (NASA-CR-127781). NTIS.

Cross sections for γ-ray production in the inelastic scattering of neutrons by light nuclei are considered. The applicability of the optical model is discussed. Based on experimental data, a cascade approach was developed to calculate the inelastic gamma production cross sections. The computer code LINGAP was used in conjunction with ABACUS-2 for the case of ^{16}O; results are compared with reported values. (auth)

14004 (ORO-4317-22) COULOMB CORRECTIONS TO THE INDUCED PSEUDOSCALAR TERM IN NUCLEAR MUON CAPTURE. Technical Report No. 73-130. Fulcher, L. P.; Mukhopadhyay, N. C. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jun 1973. 16p. Dep. NTIS $3.00.

Coulomb corrections to the induced pseudoscalar term, which appears in impulse approximation treatments of nuclear muon capture, are calculated. It is found that it is important to include the effect of finite nuclear size in order to obtain a reliable result. These corrections are found to be too small to account for the difference between the PCAC value for this term and the values necessary to understand recent muon capture experiments in ^{16}O and ^{40}Ca. (auth)

14005 (UCID-16277) ^{15}N(p,γ)^{16}O REACTION FROM E_p = 17.5 TO 27.37 MeV. O'Connell, W. J.; Heikkinen, D. W.; Dietrich, F. S. (California Univ., Livermore. Lawrence Livermore Lab.). Jun 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $3.00.

The 90° yield of ^{15}N(p,γ)^{16}O was measured from E_p = 17.50 to 27.37 MeV using the LLL cyclograaff and a 10" × 10" NaI crystal spectrometer. The yield of γ_0 decreases in this range with no pronounced structure, in agreement with other measurements. The yield to excited final states in ^{16}O is also observed when the gamma ray energy is sufficiently above the E_γ = 15.11 MeV yield from ^{15}N(p,$\alpha\gamma$). There is strong yield to the group of states around 6 to 7 MeV excitation in ^{16}O and to a group of states around 12.9 MeV, presumably the lowest T = 1 states in ^{16}O. Preliminary analysis shows that the yield to the group of states near 12.9 MeV monotonically decreases in the range E_p = 22.5 to 27.37 MeV (corresponding to a deexcitation gamma ray energy range of 20.3 to 25.1 MeV), and at E_p = 24.5 MeV the yield to this group of states is roughly 4 times the γ_0 yield. (auth)

14006 (UCRL-74746) RECENT HIGH-RESOLUTION (γ,n) MEASUREMENTS AT LIVERMORE. Berman, B. L.; Alvarez, R. A.; Faul, D. D.; Lewis, F. H. Jr.; Meyer, P. (California Univ., Livermore. Lawrence Livermore Lab.). 4 May 1973. 3p. (CONF-730301-6). Dep. NTIS $3.00.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

The (γ,n) measurements were performed on ^{9}Be, ^{12}C, ^{14}N, ^{75}As, and ^{141}Pr. From a preliminary analysis of the data it was found that the absolute cross sections for ^{12}C, ^{14}N, ^{75}As, and ^{141}Pr are in agreement with previous measurements, no gross structure was observed for ^{75}As or ^{141}Pr, some gentle structure was found for ^{141}Pr, and the data for ^{12}C show evidence for considerable fragmentation of the main giant resonance states with evidence for at least nine peaks most of which were not seen previously. (JFP)

14007 EXPERIMENTAL TEST OF NITROGEN GAMMA-RAY PRODUCTION CROSS SECTIONS USING A Ge(Li) DETECTOR. Orphan, V. J.; Hoot, C. G.; Verbinski, V. V. (Gulf Radiation Tech., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 348-349 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14008 HIGH-ENERGY PHOTODISINTEGRATION OF OXYGEN. Mancini, E. (Univ., Genoa); Ricco, G.; Sanzone, M.; Costa, S.; Ferrero, L. Nuovo Cim.; 15A: No. 4, 705-712(21 Jun 1973).

The cross section of the ^{16}O(γ,p)^{15}N reaction was measured, by means of a wide-solid-angle scintillation counter telescope, at bremsstrahlung and point energies from 50 to 80 MeV. The experimental results were compared with the available theoretical calculations. (auth)

14009 ^{7}Li + d → 2α + n REACTION. I. Analysis of the Bidimensional Spectra. D'amico, V. (Univ., Messina, Italy); Jannelli, S.; Mezzanares, F.; Potenza, R. Nuovo Cim., 15A: No. 4, 723-729(21 Jun 1973).

The bidimensional spectra of the reaction ^{7}Li + d → 2α + n with three bodies in the final state are analysed by a method that takes into account in a definite approximation the finite resolving power of the detecting system. Some experimental results on this reaction are then analysed in the system of the relative co-ordinates, that seems the most suitable to treat the effects of sequential decays. (auth)

14010 PHOTOPRODUCTIONS OF VECTOR MESONS FROM COMPLEX NUCLEI. Egusa, T. (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 206-215(Jan 1973).

Photoproductions of vector mesons from complex nuclei are reanalyzed by the simple nuclear model. Coherent and incoherent productions are evaluated by use of the strong interaction nuclear radii. Photon-vector meson coupling constants γ_ρ, γ_ω, γ_φ are also investigated. (auth)

14011 SPHERICAL AND DEFORMED CONFIGURATIONS OF ^{18}O IN THE MODEL OF K-HARMONICS WITH A POTENTIAL WELL. Trlifaj, L. (Inst. of Physics, Prague). Czech. J. Phys.; 23: No. 4, 416-430(1973).

From the point of view of the K-harmonics model an estimation of the relative positions of the spherical ($K = K_{min}$) and deformed ($K = K_{min} + 2$) configurations of ^{18}O is carried out: this is useful for more exact calculations. In these configurations the structure $(1s)^4 (1p)^{12}$ of the 16 nucleons (the hypothetical nucleus ^{16}O) is separated out as determining, and their binding energy is calculated. Nuclear forces are taken in the schematic form of a rectangular potential well. At first it is derived from the realistic nucleon-nucleon rectangular well and results in overbound states. It is, therefore, derived directly from the experimental data (the binding energy and the root-mean-square radius of ^{16}O and ^{18}O, respectively). Although the energies of the hypothetical ^{16}O nucleus are close together in both configurations of ^{18}O, they differ. In the appendix a very effective expression for the logarithmic derivative of the MacDonald function is given. (auth)

14012 ELECTROMAGNETIC AND WEAK INTERACTIONS WITH NUCLEI: ONE-BODY DENSITIES IN ^{6}Li. Donnelly, T. W.; Walecka, J. D. (Stanford Univ., CA). Phys. Lett.; 44B: No. 4, 330-334(14 May 1973).

Elastic and inelastic magnetic electron scattering and other electromagnetic data are used to determine accurately one-body densities (and wave functions) for the valence nucleons in ^{6}Li. Semileptonic weak processes are then analyzed in an essentially model-independent way. (auth)

14013 OPTICAL MODEL AND HAUSER-FESHBACH ANALYSIS OF ^{9}Be + d AND ^{10}B + p INTERACTIONS AT LOW ENERGIES. Zweiglinski, B. (Inst. of Nuclear Research, Warsaw); Piotrowski, J.; Saganek, A.; Sledzinska, I. Nucl. Phys.; A209: No. 2, 348-362(1973).

The available data for the elastic scattering of deuterons from ^{9}Be in the energy range from 1.1 to 2.5 MeV are analyzed in terms of the optical model, as an introduction to a DWBA study of the ^{9}Be(d,p)^{10}Be reaction. It was confirmed that the energy dependence of the parameters of the imaginary part of the deuteron potential is similar to that observed for other light nuclei. The angular distributions of the elastic scattering of protons from ^{10}B in the energy range from 5.5 to 12.2 MeV were found to be satisfactorily described by the combined optical model and Hauser-Feshbach theories. Satisfactory agreement was obtained between the calculated and experimental ^{10}B(p,α)^{7}Be, ^{10}B(p,p')^{10}B, and ^{10}B(p,n)^{10}C total cross sections. This seems to indicate that compound-nucleus formation is the dominant mechanism in these reactions. (9 figures, 2 tables) (auth)

14014 ELASTIC ELECTRON SCATTERING FROM ^{14}C. Kline, F. J. (Catholic Univ. of America, Washington, DC); Crannell, H.; O'Brien, J. T.; McCarthy, J.; Whitney, R. R. Nucl. Phys.; A209: No. 2, 381-395(1973).

The ground-state charge distribution of the ^{14}C nucleus was studied using elastic electron scattering. Data were accumulated and

analyzed for an incident electron energy of 374.6 MeV and for laboratory scattering angles between 32° and 70°. Cross section data for ^{12}C were also obtained, for purposes of normalization, at the same incident energy and angles. The data were fitted by phase-shift analysis to a two-parameter Fermi model and to the modified harmonic oscillator model. Both models gave reasonable fits to the ^{14}C data except in the region of the first diffraction minimum. The results for the modified harmonic oscillator model indicate that the rms radius of ^{14}C is approximately 0.10 fm larger than that of ^{12}C. (4 figures, 7 tables) (auth)

14015 $^{7}Li(\vec{d},n_0)^{8}Be$ REACTION WITH POLARIZED 800 keV DEUTERONS. von Moellendorf, U.; Janett, A.; Seiler, F.; Striebel, H. R. (Univ. Basel). Nucl. Phys., A209: No. 2, 323-332(1973).

The analyzing power of the $^{7}Li(\vec{d},n_0)^{8}Be$ reaction for vector and tensor polarization of an 800-keV deuteron beam, as well as the relative cross section for the unpolarized beam, was measured at 7 to 9 angles between 0° and 160°, by using a thick target. Analysis in terms of (l, s, J^π) matrix elements shows that two intermediate states with $J^\pi = 3/2^+$ and $J^\pi = 5/2^-$ are present, strongly interfering with each other. Assignments to known ^{9}Be levels and to threshold resonances as suggested by Hackenbroich and Seligman are briefly discussed. The magnitude of the vector analyzing power makes the reaction interesting as a monitor for the vector polarization of low-energy deuteron beams. (6 figures, 4 tables) (auth)

14016 ^{13}C STATES VIA THE $^{12}C(d,p)^{13}C$ REACTION. Goss, J. D.; Rollefson, A. A.; Marolt, G. L.; Browne, C. P. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. C 7: No. 2, 663-668 (Feb 1973).

Protons from the $^{12}C(d,p)^{13}C$ reaction were analyzed with a magnetic spectrograph. Bombarding energies ranged from 14.0 to 15.5 MeV and observation angles ranged from 20 to 120°. Eight states were found in ^{13}C between 10.7- and 12.2-MeV excitation energy. Excitation energies and (widths) in keV are: 10755±5 (56±2), 10818±5 (24±3), 10997±8 (82±15), 11080±5 (<8), 11748±10 (107±14), 11851±5 (68±4), 11970±40 (≈260), and 12108±5 (81±8). The level at 11851 has not been reported before. Uncertainties in excitation energies are reduced by as much as a factor of 4 from previous work. (auth)

14017 MASS OF THE SECOND EXCITED STATE OF ^{12}C. McCaslin, S. J.; Mann, F. M.; Kavanagh, R. W. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. C 7: No. 2, 489-493 (Feb 1973).

By the simultaneous measurement of the magnetic rigidity of the α_0^{++} and α_2^+ groups from the $^{15}N(p,\alpha)^{12}C$ reaction, using a double-focusing spectrometer, the excitation energy of the second excited state of ^{12}C is found to be 7654.2 ± 1.6 keV. (auth)

14018 PROTON CAPTURE BY ^{7}Be AND THE SOLAR NEUTRINO PROBLEM. Robertson, R. G. H. (Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 7: No. 2, 543-547 (Feb 1973).

It is shown theoretically that the $^{7}Be(p,\gamma)^{8}B$ reaction cross section contains substantial contributions from p and d partial waves at laboratory energies, and extrapolations to stellar energies based on the assumption of pure s-wave capture are therefore erroneous. However, there is no change in the predicted solar neutrino flux, because the calculated low-energy cross-section factor, 31 eV b, is essentially the same as the empirical value in current use. (auth)

14019 A UNIFIED R-MATRIX-PLUS-POTENTIAL ANALYSIS FOR ^{16}O + n CROSS SECTIONS. Johnson, C. H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 7: No. 2, 561-573 (Feb 1973).

A multilevel two-channel R-matrix analysis is made for both the neutron total and angle-integrated (n,α) cross sections of ^{16}O for 0-5.8-MeV neutrons. Off-resonant phase shifts are described by scattering in a real Saxon-Woods local potential with a spin-orbit term and a parity dependence for the well depths. The well parameters are chosen to bind the $1d_{5/2}$ and $2s_{1/2}$ levels at the energies of the lowest two states in ^{17}O and the quasibound $1d_{3/2}$ level at the centroid of five observed $3/2^+$ resonances. The $1d_{3/2}$ level is replaced by these five fragments which contain nearly 100% of the $1d_{3/2}$ strength and have their eigenenergy centroid at 5.74 MeV in ^{17}O. The 5.08-MeV level in ^{17}O has 69% of the strength. The R-matrix boundary radius must be chosen carefully inside the tail of the potential in order to subtract the $1d_{3/2}$ state and in order to place the unbound 2p and 1f states at energies consistent with the observed p- and f-wave fragments. Spectroscopic factors are deduced for 26 levels in ^{17}O between 4.5 and 9.5 MeV and the sums of these factors are 1% for $J^\pi = 1/2^+$; 5% for $1/2^-$; 12% for $3/2^-$; 99% for $3/2^+$; 0.1% for $5/2^+$; 1% for $5/2^-$ and 14% for $7/2^-$. Thus, the observed single-particle structure of ^{17}O in both the bound and unbound region is described by an R-matrix-plus-potential analysis. (auth)

14020 STUDY OF THE REACTIONS $^{9}Be(p,\alpha)$ AND $^{9}Be(p,d)$ AT LOW ENERGIES. Sierk, A. J. Pasadena, CA; California Inst. of Tech. (1973). 75p. University Microfilms Order No. 73-14,317. Thesis (Ph.D.).

Cross sections for the $^{9}Be(p,d)$ and (p,α) reactions were measured for proton lab energies of 30 to 700 keV. Angular distributions were measured for energies of 100 to 600 keV. Absolute normalization of the cross sections was done by measuring cross sections for Rutherford-scattered α particles. The maximum cross sections observed at the 330 keV $J^\pi = 1^-$ resonance were (360 ± 20) mb for (p,α) and (470 ± 30) mb for (p,d). The value of $S_{cm}(E = 0)$ for the combined cross sections was estimated to be (35^{-15}_{+45}) MeV-barn. The reaction data were interpreted in terms of an R-matrix compound nucleus model. There were no obvious effects due to direct reactions. The low-energy behavior of the cross sections was fitted by using three ^{10}B resonance levels: a $J^\pi = 2^+$ level at −20 keV (cm), a 1^- level at 310 keV, and a 1^+ level at 410 keV. (Diss. Abstr. Int., B)

14021 EFFECT OF THE INTRODUCTION OF α-CHANNELS ON THE CONTINUUM STRUCTURE OF ^{16}O. Delsanto, P. P. (Univ. of Puerto Rico, Mayaguez); Barrett, R. F.; Wahsweiler, H. G. Phys. Lett., 44B: No. 5, 433-436(28 May 1973).

A phenomenological model in which α-particle cluster channels are coupled to the usual 1p-1h continuum configurations is proposed in order to explain the structure experimentally observed in the ^{16}O photo-cross sections around 21 MeV. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 14010, 14042, 14044, 14046, 14061, and 14093.

14022 (SUNI-23, pp 24-25) ANGULAR CORRELATION METHODS FOR THE STUDY OF SPINS AND MIXING RATIOS. Haupt, P.; Koen, J. W.; Naude, W. J. 1972.

14023 (SUNI-23, pp 31-33) TRANSFER REACTIONS INDUCED BY 38 MeV FLUORINE IONS ON ALUMINUM. McMurray, W. R.; Hooton, B. W.; Conlon, T.; Ivanovich, M. 1972.

14024 PAIRING CORRELATIONS AND SIMULTANEOUS PROJECTION OF PARTICLE NUMBER AND ANGULAR MOMENTUM IN LIGHT NUCLEI. Goeke, K. (Kernforschungsanlage, Juelich, Ger.); Garcia, J.; Faessler, A. Nucl. Phys.; A208: No. 3, 477-502(1973).

The Hartree-Bogolubov theory with simultaneous projection on sharp angular momentum quantum number and sharp particle number is presented as a description of the ground state rotational bands of doubly even nuclei. Calculations with effective G-matrix elements of the Hamada-Johnston potential and also of the Yale potential were performed within this framework for the nuclei ^{20}Ne, ^{22}Ne, ^{24}Ne, ^{24}Mg, ^{26}Mg, ^{28}Si, ^{30}Si, ^{32}S, and ^{34}S. Rotational energies, moments of inertia, pairing correlations, quadrupole moments and B(E2) values are discussed and compared with available experimental data. The effect of particle number fluctuation on the ground state rotational spectrum and on the intrinsic wave function is investigated. The particle number projection turns out to be important for the description of the rotational levels, whereas it has only a negligible effect on the properties of the intrinsic wave function. Comparison with Hartree-Fock results and with experimental data shows that the inclusion of pairing correlations provides a significant improvement on the excitation energies, their relative ratios and the angular momentum dependence of the moments of inertia. All solutions show an antistretching effect in the quadrupole moments and especially in the B(E2) values. The rotational bands in ^{20}Ne, ^{22}Ne, ^{24}Ne, and ^{28}Si turn out to be well described in the framework presented. (auth)

14025 ACTIVATION CROSS SECTION FOR $^{27}Al(\pi^+,\pi^0)^{27}Si$ AT 100 MeV. Plendl, H. S.; Richter, A.; Umbarger, C. J. (Florida State Univ., Tallahassee). Nucl. Phys., B57: No. 2, 348-354 (1973).

The activation cross section for $^{27}Al(\pi^+,\pi^0)^{27}Si$ at $E_\pi = 99 \pm 9$ MeV was determined to be 5.1 ± 2.2 mb by counting the residual β^+ activity of ^{27}Si. This result is compared with other pion-nucleus cross sections. A value for the elementary pion-nucleon cross section inside the nucleus is derived from this result and compared with an estimate from a phenomenological expression. (auth)

14026 HIGH SPIN NEGATIVE PARITY STATES IN ^{29}Si ASSOCIATED WITH OBLATE DEFORMATION. Viggars, D. A.; Butler, P. A.; Carr, P. E.; Gadeken, L. L.; James, A. N.; Nolan, P. J.; Sharpey-Schafer, J. F. (Univ. of Liverpool). J. Phys., A (London); 6: No. 6, L67-L72(Jun 1973).

Spin and parity assignments of $11/2^-$ and $13/2^-$ have been made for

levels at 6.781 MeV and 8.761 MeV, respectively, in ^{29}Si by using angular correlation, γ-ray linear polarization and lifetime measurements. The properties of the levels are consistent with their being high-spin members of a $K^\pi = 7/2^-$ rotational band based on the Nilsson orbit [303] with oblate deformation. (auth)

14027 MEASUREMENTS OF NEUTRON REACTION CROSS SECTIONS USING A LIQUID SCINTILLATION SPECTROMETER. Ishikawa, H. (Japan Atomic Energy Research Institute, Tokyo). Nucl. Instrum. Methods; 109: No. 3, 493-501(1973).

The thermal neutron reaction cross sections for ^{2}D, ^{62}Ni, ^{34}S, ^{44}Ca, and ^{31}P have been determined by an activation method. Radioactivities of neutron-induced nuclides were accurately measured utilizing a liquid scintillation spectrometer. Since this technique has the advantage of measuring the radioactivities without any absorption and scattering of radiations under a 4π geometry, it is possible to find highly accurate values for the reaction cross sections. The results obtained for ^{2}D(n,γ)^{3}T, ^{62}Ni(n,γ)^{63}Ni, ^{34}S(n,γ)^{35}S, ^{44}Ca(n,γ)^{45}Ca, and ^{31}P(n,γ)^{32}P reactions are respectively 0.55 ± 0.01 mb, 15.89 ± 0.52 b, 0.23 ± 0.003 b, 0.78 ± 0.01 b and 0.17 ± 0.01 b. In this study, ^{50}Cr was adopted as a neutron flux monitor. (auth)

14028 MEASUREMENT OF THE HALF-LIFE OF ^{37}Ar. Colomer, J.; Gauvain, D. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Int. J. Appl. Radiat. Isotop.; 24: No. 7, 391-393(Jul 1973). (In French).

The half-life of ^{37}Ar against decay was observed to be 35.06 ± 0.18 days, by use of gas proportional counters. (auth)

14029 TRANSFER CONTRIBUTION TO INELASTIC SCATTERING: PICK-UP CHANNELS AND PROTON INELASTIC SCATTERING FROM ^{24}Mg. Mackintosh, R. S. (Australian National Univ., Canberra). Nucl. Phys., A209: No. 1, 91-108(1973).

The pair of reactions ^{24}Mg(p,p′) and ^{24}Mg(p,d), strongly coupled together in a model in which the nucleons are treated as spinless, were studied by using coupled channel techniques. It was found that the pick-up reaction is greatly modified by the coupling back to the proton channels. At the same time, the deuteron channel affects the proton scattering to the extent of a marked reduction in the extracted deformation parameters. (auth)

14030 ISOSPIN EFFECTS IN THE GIANT DIPOLE RESONANCE OF ^{42}Ca. Diener, E. M.; Amann, J. F.; Paul, P. (Department of Physics, State University of New York, Stony Brook, New York 11790); Vergados, J. D. Phys. Rev. C 7: No. 2, 705-713 (Feb 1973).

The giant dipole resonance (GDR) of ^{42}Ca was investigated through the ^{41}K(p,γ$_0$)^{42}Ca reaction. The gross structure indicates two peaks at 17.4±0.1 MeV (Γ=3.3±0.5 MeV) and 20.4±0.1 MeV (Γ=4.4±0.1 MeV) which contain 13 and 87%, respectively, of the E1 strength in the (γ,p$_0$) channel. From a comparison of structure and excitation energies of the GDR in ^{40}Ca and ^{42}Ca, the two peaks can be identified with the T=1 (at 17.4 MeV) and the T=2 (at 20.4 MeV) isospin components of the GDR. This energy separation gives an effective symmetry potential of V=63 MeV in agreement with the general predictions and observation in other nuclei. However, identification of the peaks with the K=0 and K=1 dipole oscillations in the deformed ^{42}Ca ground state is not ruled out. A shell-model calculation of the dipole states in ^{42}Ca with good isospin was done by diagonalizing large matrices and using the Kuo-Brown G-matrix elements. This gives a concentration of T=1 strength at 17.1 MeV and T=2 strength at 19.6 MeV, in good agreement with the experimental results, and supports the isospin identification of the two components. (auth)

14031 SHELL-MODEL CALCULATION FOR MASSES 27, 28, AND 29: GENERAL METHODS AND SPECIFIC APPLICATIONS TO ^{27}Al, ^{28}Si, AND ^{29}Si. Wildenthal, B. H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48823); McGrory, J. B. Phys. Rev. C 7: No. 2, 714-732 (Feb 1973).

A shell-model calculation for A=27, 28, and 29 nuclei has been carried out in a truncated $0d_{5/2}$–$1s_{1/2}$–$0d_{3/2}$ basis space with a modified-surface-δ-interaction Hamiltonian. A comparison of the calculated results for level energies, single-nucleon spectroscopic factors and E2 and M1 transition strengths in ^{27}Al, ^{28}Si, and ^{29}Si with the corresponding experimental values indicates that a unified and quantitive explanation of nuclear structure around A=28 can be obtained via shell-model techniques. (auth)

14032 CALCULATIONS OF ALLOWED BETA DECAY IN THE (0d,1s) SHELL. Lanford, W. A.; Wildenthal, B. H. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48823). Phys. Rev. C 7: No. 2, 668-676 (Feb 1973).

Allowed β-decay transition rates and half-lives have been calculated for (0d,1s) shell nuclei with A=17–22, 23–24, 27–29, 30–34, and 35–39. For nuclei with A=17–22 and 34–39, the calculated logft values have a rms deviation of 5% from experiment, with no discrepancies greater than 12%. For nuclei nearer the middle of the shell there are more significant discrepancies between experiment and theory. The calculated logft values are used to predict the half-lives of some light elements. The predicted half-lives for which there are no experimental measurements are: ^{20}Mg (0.1 sec), ^{21}O (1.2 sec), and ^{22}O (0.15 sec). The logft values relevent to the solar neutrino experiment are discussed. (auth)

14033 PROTON CAPTURE INTO THE GIANT DIPOLE RESONANCE OF ^{40}Ca. Diener, E. M.; Amann, J. F.; Paul, P. (Department of Physics, State University of New York, Stony Brook, New York 11790). Phys. Rev. C 7: No. 2, 695-704 (Feb 1973).

The ^{39}K(p,γ)^{40}Ca reaction has been studied from 6.5 to 17 MeV bombarding energy covering the electric giant dipole resonance (GDR) in ^{40}Ca. The GDR displays fine, intermediate, and gross structure. A fluctuation analysis of the fine structure gives a coherence width ≈25 keV and indicates that compound levels contribute <3% to the total dipole strength. The intermediate structure has widths clustered between 150 and 450 keV. Despite the large yield fluctuations angular distributions have a uniform shape throughout the GDR with A_2=–0.33, characteristic of dominating f-wave capture. A broad coherent state observed at 19.3 MeV contains 90% of the capture strength with the remainder contained in a weak broad peak at 22 MeV. These positions and relative strengths agree well with calculations of the coherent dipole states based on 1p–1h excitations. However, continuum calculations fail to predict the total widths and angular distributions. (auth)

14034 (^{16}O,^{15}N) REACTION ON 2s–1d- AND 1f–2p-SHELL NUCLEI. Maher, J. V.; Erb, K. A.; Miller, R. W. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania). Phys. Rev. C 7: No. 2, 651-663 (Feb 1973).

The (^{16}O,^{15}N) reaction has been studied on targets of ^{24}Mg, ^{27}Al, ^{28}Si, ^{45}Sc and ^{46,48}Ti and finite-range distorted-wave calculations have accounted well for the extreme Q dependences (arising from angular momentum mismatch) of the cross sections, yielding spectroscopic factors in good agreement with spectroscopic factors extracted from light-ion-induced reactions. This agreement is interpreted as an indication that the heavy-ion-induced proton transfer reaction—when it populates states of strong single-particle character—can be well understood within the framework of the distorted-wave theory. (auth)

14035 GAMMA TRANSITIONS IN ^{37}Cl FOLLOWING THE β^- DECAY OF ^{37}S. Klotz, G.; Walter, G. (Centre de Recherches Nucléaires, Strasbourg-Cronenbourg, France). Phys. Rev. C; 7: No. 2, 854-855 (Feb 1973).

γ rays following the β decay of ^{37}S have been observed with a Ge(Li) detector during the course of a study of the decay modes of ^{40}Cl. These two isotopes have been produced simultaneously through the ^{40}Ar(n,α) and ^{40}Ar(n,p) reactions. The energies and relative intensities of the two lines (3103.3 ± 0.3 keV, 99.7% and 3741.8 ± 0.4 keV, 0.3%) measured earlier in this laboratory using the ^{37}Cl(n,p)^{37}S reaction, are confirmed. No transition with the energy of 3706±2 keV and the decay rate of ^{37}S has been found. Nevertheless a γ ray of 3704.6±0.8 keV is shown clearly to arise from the deexcitation of ^{40}Ar. (auth)

14036 COMPARISON OF THE ^{27}Al(^{3}He,^{3}He′)^{27}Al AND ^{27}Al(^{3}He,t)^{27}Si REACTIONS AT 18 MeV. Holden, J. E.; Balamuth, D. P.; Fortune, H. T.; Zurmühle, R. W. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. C 7: No. 2, 611-619 (Feb 1973).

The ^{27}Al(^{3}He,^{3}He′)^{27}Al and ^{27}Al (^{3}He,t)^{27}Si reactions have been studied at an incident-beam energy of 18 MeV. Angular distributions were measured for many low-lying states. The transitions to states below 3.00 MeV excitation in the two reactions were compared using the macroscopic-interaction model of the distorted-wave Born approximation, using a generalized isospin-dependent optical-mode potential. The observed L=4 strength in the (^{3}He,t) reaction is inconsistent with both the inelastic scattering results of this work and other measurements of the hexadecapole deformation in this region, indicating that the inelastic scattering and charge-exchange processes may be microscopically more distinct than is suggested by the macroscopic model. Angular distributions for states in ^{27}Si above 3 MeV excitation are also presented and discussed. The (^{3}He,t) study also showed that the ^{27}Si state of E_x=4.46 MeV is an unresolved doublet, confirming other recent work. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 14004, 14027, 14034, 14057, 14061, 14066, 14067, 14093, 14121, and 14137.

14037 (AERE-R-7425) PRELIMINARY MEASUREMENT OF THE NEUTRON TOTAL CROSS SECTION OF IRON FROM 24 keV

TO 1000 keV USING THE HARWELL SYNCHROCYCLOTRON. Pattenden, N. J.; Belcher, I. T.; Blair, I. M.; Bowen, P. H.; Cox, G. C.; Dolley, P. E.; McMurray, W. R. (Atomic Energy Research Establishment, Harwell (England)). Apr 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25. UK 50 pence.

A description is given of the Harwell synchrocyclotron neutron time-of-flight spectrometer, which had a resolution of ~0.07 nsec/m. Total cross section measurements on a sample of thickness 0.2546 Fe atom/barn are described together with an estimation of errors and a comparison with other data. Many narrow resonances were detected, which had not been reported previously in total cross section measurements. Minimum cross section values are given for regions of interference between resonance and potential scattering. (auth)

14038 (CONF-730538-1) NEUTRON CAPTURE CROSS SECTIONS OF THE ISOTOPES OF CALCIUM AND BARIUM. Allen, B. J.; Chan, D. M. H.; deL. Musgrove, A. R.; Macklin, R. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1971. 14p. Dep. NTIS $3.00.

From national soviet conference on neutron physics; Kiev, USSR (28 May 1973).

The neutron capture cross sections of ^{40}Ca, ^{42}Ca, ^{43}Ca, ^{44}Ca and ^{134}Ba, ^{135}Ba, ^{136}Ba, ^{137}Ba, ^{138}Ba were measured with enriched samples at the Oak Ridge Electron Linear Accelerator. Total energy detectors were used at a flight path of 40 metres, and a thin ^{6}Li glass monitored the neutron flux in the transmission mode. Energy resolution was about 0.2 per cent. Resonance parameters were obtained over the energy range 2.5 keV to several hundred keV, and average cross sections and strength functions were deduced. (6 figures, 1 table) (auth)

14039 (ORNL-TM-4252) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH CALCIUM FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.7 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 61p. Dep. NTIS $5.25.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with calcium have been obtained for neutron energies between 0.7 and 20 MeV for θ_γ = 125 deg. The $d^2\sigma/d\omega dE$ values were obtained using a NaI spectrometer. These data consist of gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \approx 9$ MeV. Neutron energy intervals varied from 0.5 MeV for $E_n \leq 9$ MeV to 3 MeV for $E_n \leq 14$ MeV. (23 figures, 23 tables) (auth)

14040 (SUNI-23, pp 22-24) SPINS OF LEVELS IN ^{41}Ca. Cornell, J. C.; McMurray, W. R.; Brooks, F. D. 1972.

14041 (SUNI-23, pp 25-27) SPINS OF ^{45}Sc LEVELS. Rust, N. J. A.; Naude, W. J. 1972.

14042 MEASUREMENT OF SEVERAL (n,p) REACTION CROSS SECTIONS USING ACTIVATION METHODS. Smith, D. L.; Meadows, J. W. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 312 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14043 MEASUREMENT OF THE ^{50}Cr(γ,n)^{49}Cr CROSS SECTION WITH MONOCHROMATIC γ-RAYS. Del Bianco, W.; Kundu, S.; Boucher, P. (Univ. of Montreal). Nucl. Phys.; A209: No. 1, 181-188(1973).

The ^{50}Cr(γ,n)^{49}Cr cross section was measured over the energy range E_γ = 20.43 to E_γ = 22.22 MeV by using monochromatic γ rays from the ^{3}H(p,γ)^{4}He reaction and detecting the resulting ^{49}Cr position activity. The γ rays were monitored by a 12.7 cm × 15.2 cm NaI(Tl) crystal. The position activity was determined by a coincidence detector consisting of two 7.62 cm × 7.62 cm NaI(Tl) crystals set on the annihilation radiation photopeaks. The γ-ray energy resolution was less than 110 keV over the whole energy range. Structure in the cross section was not observed. (auth)

14044 SYSTEMATICS OF NUCLEAR SINGLE-PARTICLE STATES. I. The Region $35 \leq A \leq 65$. Millener, D. J.; Hodgson, P. E. (Nuclear Physics Lab., Oxford). Nucl. Phys., A209: No. 1, 59-71(1973).

The energies of single-particle states in nuclei with $35 \leq A \leq 65$ are obtained as eigenvalues of a local Saxon-Woods potential with depth depending linearly on A and on the nuclear symmetry parameter. (auth) (1 figure, 7 tables).

14045 THEORY OF PAIRING VIBRATION MODE. Ui, H.; Sagawa, H. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 49: No. 2, 491-506(Feb 1973).

A simple and exactly solvable model is proposed which exhibits all the characteristic features of the pairing vibration model of A. Bohr; the near-harmonic level sequences and the strong enhancements of the (L = 0) two-nucleon transfer reaction. This model consists of degenerate many-j single particle levels and degenerate hole levels with an energy-gap between them. The pairing interactions are taken into account, except for those between the particle and hole states. Using the empirical values of the single particle and hole energies together with the strength of the pairing interaction, the model is compared with the experimental data in Ni, Sn, and Pb isotopes to get quantitative agreement. This model is further used as the basis states to diagonalize the more realistic case of the nondegenerate model with pairing interactions among all levels. It is found that the pairing vibration mode remains predominantly in the ground state of the nondegenerate model. (auth)

14046 GAMMA RAY STUDY OF ^{40}K. Davis, C. K.; Jones, G. D.; Main, I. G.; McCrone, B. T.; Thomas, M. F.; Twin, P. J. (Univ. of Liverpool). J. Phys., A (London); 6: No. 6, 844-866 (Jun 1973).

The electromagnetic decay scheme of ^{40}K below an excitation of 3.2 MeV has been measured using the ^{37}Cl(α,n)^{40}K reaction in conjunction with both a Si(Li)-Ge(Li) and a Ge(Li)-NaI(Tl) coincidence system. Gamma ray angular distribution and angular correlation measurements were also made using both the ^{40}Ar(p,n)^{40}K and ^{37}Cl(α,n)^{40}K reactions. Four unique spin assignments were made to levels at 2398 keV (4$^-$), 2419 keV (2$^-$), 2787 keV (3) and 3147 keV (1). Spin restrictions were placed on other levels; and both branching ratios and multipole mixing ratios, determined for several transitions. A shell model calculation, using the effective surface delta interaction, was performed. The predictions, in good agreement with the present experimental results, showed that the low-lying states of positive parity are well described by two-particle-two-hole excitations involving only the $1d_{\frac{5}{2}}$ and $1f_{\frac{7}{2}}$ orbits. (auth)

14047 STUDY OF THE (d,α) REACTION APPLIED TO ^{50}Cr AND ^{52}Cr. Bachner, D.; Van Der Giet, G.; Lance, D. (Univ., Bonn). Nucl. Phys.; A209: No. 2, 373-380(1973).

The reactions ^{50}Cr(d,α)^{48}V and ^{52}Cr(d,α)^{50}V were carried out at an incident deuteron energy of 15 MeV to investigate the structure of the low-lying levels of ^{48}V and ^{50}V in the light of shell-model expectations. Excitation energies and angular distributions were measured for states up to about 1.5 MeV. For all resolved and strongly excited levels angular momentum transfers could be assigned by comparison with DWBA calculations. For ^{50}V spectroscopic factors were extracted in relative units by assuming pure configurations for the transferred pair of nucleons. The results indicate the existence of seniority and configuration mixing in the level structure of the ^{48}V and ^{50}V isotopes. In both reactions some transitions show characteristic deviations from the direct reaction mechanism. These deviations cannot be reproduced by the DWBA calculations. (6 figures, 3 tables) (auth)

14048 STUDY OF ^{42}K, ^{42}Ca, ^{46}K, AND ^{46}Ca BY PICKUP REACTIONS. Dupont, Y.; Martin, P.; Chabre, M. (Institut des Sciences Nucleaires, BP 257, Centre de Tri, 3044 Grenoble, France). Phys. Rev. C 7: No. 2, 637-650(Feb 1973).

The ^{44,48}Ca(p,t)^{42,46}Ca and ^{43}Ca(p,d)^{42}Ca reactions have been investigated at 40 MeV, and the ^{44,48}Ca(p,^{3}He)^{42,46}K reactions at 40 and 56 MeV. Analysis of angular distributions leads to new spin assignments. Distorted-wave Born-approximation calculations are performed for (p,d) and (p,t) reactions. The nucleus ^{42}Ca being reached by both reactions, comparison is made between the results of calculations of the two processes. Potassium isotopes are studied through the comparison of analog states observed in the (p,t) reaction with the states reached in the (p,^{3}He) reaction. In the (p,^{3}He) spectra, the analogs of the ^{42}Ar and ^{46}Ar ground states have been identified. (auth)

14049 SPECTROSCOPY OF ^{52}Mn VIA THE ^{54}Fe(d,α)^{52}Mn REACTION AND The ^{52}Cr(p,nγ)^{52}Mn COINCIDENCE EXPERIMENT. DelVecchio, R. M. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 7: No. 2, 677-690 (Feb 1973).

The ^{54}Fe(d,α)^{52}Mn reaction was studied at 17-MeV bombarding energy. Energy assignments based on the (d,α) and two (^{3}He,t) spectra were made for some 60 levels up to about 4 MeV of excitation in ^{52}Mn with accuracies ranging from ±1 to ±10 keV. (d,α) L-transfer assignments or suggestions were made for 28 of these levels based on a recent distorted-wave Born-approximation procedure. Spin-parity limits based on the (d,α) analysis are generally in agreement with other work although a few discrepancies are noted. The ^{52}Cr(p,nγ) ^{52}Mn coincidence experiment was performed at bombarding energies of 8.0, 9.0, 9.5, and 10.0 MeV. 30 γ rays were fitted into a decay scheme which includes four previously unreported levels below 1.3 MeV of excitation in ^{52}Mn. Two of these new levels were weakly excited in (d,α), while the other two appeared as an unresolved group in the (^{3}He,t) spectra. Sine the γ-rays were observed with 3-keV Ge(Li)

detector resolution, accurate energy assignments ($\leq \pm 0.5$ keV) could be made for 14 levels in ^{52}Mn. The γ-ray data are consistent with the (d,α) spin limits. A comparison of the low-lying states with the McCullen, Bayman, and Zamick calculations is presented. The four new levels do not fit into the pure $f_{7/2}$-shell scheme. (auth)

14050 STRAIGHT-BACK ELASTIC ALPHA SCATTERING FROM ^{48}Ti, ^{52}Cr, ^{53}Cr, AND ^{58}Ni. Sewell, P. T.; Hafele, J. C. (Department of Physics, Washington University, St. Louis, Missouri 63130); Foster, C. C.; O'Fallon, N. M.; Fulmer, C. B. Phys. Rev. C 7: No. 2, 690-694 (Feb 1973).

Cross sections are reported for α particles scattered from ^{58}Ni, ^{52}Cr, ^{53}Cr, and ^{48}Ti. For the ^{58}Ni target, both elastic and inelastic (to the first excited state) data are presented for α particles of 12 incident energies between 13 and 29 MeV scattered into the angular range from 152° through 180° to -172°. Elastic excitation functions at 180° are given for α particles of six energies between 20 and 29 MeV scattered from ^{52}Cr, ^{53}Cr, and ^{48}Ti. The elastic angular distributions exhibit a narrow "glory peak" at 180° for each energy, and the peak cross section at 180° is sensitively dependent on both the bombarding energy and the target mass. For the case of ^{58}Ni, the measured elastic cross sections at 180° are about an order of magnitude larger than values predicted from optical-model calculations with a potential that fits α scattering data forward of 140°. (auth)

14051 PROTON ELASTIC SCATTERING AND COUPLING TO PICKUP CHANNELS. Mackintosh, R. S. (Australian National Univ., Canberra). Phys. Lett.; 44B: No. 5, 437-439(28 May 1973).

Calculations were carried out for elastic scattering of protons on ^{40}Ca in which pickup channels are strongly coupled to the elastic channels. These calculations strongly suggest that transfer channels contribute significantly to both the real and imaginary parts of the local optical potential. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 14006, 14010, 14027, 14044, 14045, 14061, 14069, 14070, 14098, and 14129.

14052 (SUNI-23, pp 21-22) PROPERTIES OF EXCITED LEVELS IN ^{65}Zn. van Heerden, I. J.; van Reenen, R. J.; Pilcher, J. V. 1972.

14053 PRODUCTION CROSS SECTIONS OF ISOMERS IN As, Y, In, AND Hf WITH 14.8-MeV NEUTRONS. Salaita, G. N.; Eapen, P. K. (Southern Methodist Univ., Dallas). Trans. Amer. Nucl. Soc.; 16: 59-60(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14054 NUCLEAR QUADRUPOLE MOMENTS OF RADIOACTIVE ^{83}Rb, ^{84}Rb, AND ^{86}Rb. Ackermann, F.; Platz, I.; zu Pulitz, G. (Univ., Heidelberg). Z. Phys.; 260: No. 2, 87-110(1973).

Excited atomic $^2p_{\frac{1}{2}}$ states of radioactive Rb isotopes have been investigated by level crossing and optical double resonance spectroscopy. From the measured hyperfine structure constants the magnetic moment of ^{84}Rb, the nuclear quadrupole moments of ^{83}Rb, ^{84}Rb, ^{86}Rb, and the hyperfine anomaly $_{84}\Delta_{85}$ have been determined. The quadrupole moments of ^{83}Rb to ^{87}Rb can be explained with the unified model of vibrations. (11 figures, 4 tables) (auth)

14055 DISSOCIATION AND STRIPPING OF 9.4 GeV/c DEUTERONS ON PHOTOEMULSION NUCLEI. Azimov, S. A.; Basova, E. S.; Gulyamov, U. G.; Petrov, V. I.; Chernov, G. M. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 49-53(1973). (In Russian).

The proton stripping of deuterons with a moment of 9.38 GeV/c on photoemulsion nuclei was investigated. A layer of type BR-2 emulsion $10 \times 20 \times 0.04$ cm^3 was irradiated with a deuteron beam from a synchrotron. The distribution of relativistic particles from inelastic d-A interactions was determined relative to the angular distribution of stripped protons, and to the background tracks. (2 figures) (KSW)

14056 STUDY OF THE ^{59}Co(n,γ) REACTION WITH A POLARIZED TARGET AND POLARIZED THERMAL NEUTRONS. Honzatko, J.; Sebek, J.; Kajfosz, J.; Stehno, J.; Kosina, Z.; Konecny, K. (Inst. of Nuclear Physics, Rez, Czech.). Nucl. Phys.; A209: No. 2, 245-251(1973).

The asymmetry of 20 primary γ transitions following the radiative capture of polarized thermal neutrons by ^{59}Co nuclei was measured with the aim of determining spins of the ^{60}Co excited states and a parameter η characterizing the contributions of the two capturing states, 3^- and 4^-, to different transitions. The nuclei were polarized by the h.f.s. method at a temperature of 0.12°K. Interpretation of the experimental results was carried out with the coherent interference of the two capturing states taken into account. The following spins were determined unambiguously: $J^\pi(276) = 4^+$, $J^\pi(288) = 3^+$, $J^\pi(613) = 3^+$, and $J^\pi(1514) = 4^+$. The spin assignments of the other levels were restricted. (1 figure, 2 tables) (auth)

14057 SPIN-ORBIT AND TARGET-SPIN EFFECTS IN HELION ELASTIC SCATTERING. Fulmer, C. B.; Hafele, J. C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 7: No. 2, 631-637 (Feb 1973).

The well depth of the spin-orbit term for the helion-nucleus optical-model potential was determined by performing parameter searches for elastic scattering data at successive fixed values of V_s. Resulting plots of χ^2/N vs V_s show consistent minima for the 13 data sets used. Elastic angular distributions studied were for ^{60}Ni at four energies between 35 and 71 MeV and for three groups of neighboring even and odd mass targets at energies between 60 and 71 MeV. The χ^2/N vs V_s plots for all the even mass (I=0) targets have minima at values of V_s between 2.0 and 3.0 MeV, while the plots for all the odd mass (I+0) targets have minima about 1 MeV greater (3.0 to 4.0 MeV). This difference in the best-fit values of V_s is consistent over a wide range of target mass and of scattering energy, and suggests the presence of a detectable target-spin interaction in helion elastic scattering. (auth)

14058 STATES IN ODD-ODD ^{62}Cu POPULATED BY THE DECAY OF ^{62}Zn. Giesler, G. C.; McHarris, Wm. C.; Warner, R. A. (Department of Chemistry, Cyclotron Laboratory, Department of Physics, Michigan State University, East Lansing, Michigan 48823); Kelly, W. H. Phys. Rev. C 7: No. 2, 620-631 (Feb 1973).

The decay of 9.2-h ^{62}Zn to states in odd-odd ^{62}Cu has been studied with the aid of large-volume Ge(Li) γ-ray detectors. 19 γ rays were found to belong to this decay, and all were placed in a decay scheme containing states in ^{62}Cu at 0 ($J^\pi = 1^+$), 40.94 (2^+), 243.44 (2^+), 287.98 (2^+), 426.3 (3^+), 548.4 (1^+), 637.5 (1^+), 915.6 ([1]$^+$), 1142.5 ([0,1]$^+$), 1280.8 ([0,1]$^+$), and 1429.9 keV ([1]$^+$). These were combined with existing inbeam γ-ray and particle-transfer data to yield a rather complete ^{62}Cu level scheme. The status of shell-model calculations in this nuclear region is discussed, and it is demonstrated that a gratifying number of facts about the low-lying ^{62}Cu states can be explained using simple odd-odd configurations as predicted by the neighboring odd-mass nuclei. (auth)

14059 MEASUREMENTS OF γ-γ DIRECTIONAL CORRELATIONS IN ^{79}BR. Borchert, I.; Koch, F.; Schumacher, M. (Univ., Goettingen, Ger.). Z. Phys.; 260: No. 1, 81-86(1973). (In German).

By using gaseous and solid sources of ^{79}Kr the $\gamma\gamma$ directional correlations of the 208.6-397.6-keV, 299.6-306.6-keV, and 381.1-217.1-keV $\gamma\gamma$ cascades of ^{79}Br were measured. The results allow the unambiguous assignment of spin and parity to the levels at 397.6 keV ($^1/_2^-$) and 306.6 keV ($^1/_2^-$). In addition, they confirm the assignment to the level at 217.1 keV ($^5/_2^-$). (auth)

14060 M1 AND E2 TRANSITIONS IN ^{59}Ni. Singh, R. P.; Raj, R.; Rustgi, M. L. (State Univ. of New York, Buffalo). Phys. Lett.; 44B: No. 5, 409-410(28 May 1973).

Employing the Kuo-Brown interaction, M1 and E2 transition rates for the low-lying levels of ^{59}Ni are calculated, and the results are found to be in reasonably good agreement with the observed values. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 14006, 14038, 14045, 14053, 14057, 14084, 14093, 14125, and 14138.

14061 (SUNI-23) ANNUAL RESEARCH REPORT, 1972. McMurray, W. R. (comp.). (Southern Universities Nuclear Inst., Faure (South Africa)). 1972. 93p. Dep. NTIS (U. S. Sales Only) $6.75.

The operation, maintenance, and development of the 5.5-MV van de Graaff accelerator are described first. Then a number of studies on nuclear structure and dynamics and nuclear chemistry are reported. Further sections of the document are concerned with application of nuclear techniques, Atomic Energy Board units, apparatus and techniques, research publications and reports, and staff and students. (30 figures, 4 tables) (RWR)

For title listing of selected items see: 12607-12610, 12660, 12661, 12772, 13993, 13994, 14022, 14023, 14040, 14041, 14052, 14062, and 14081.

14062 (SUNI-23, pp 29-30) COULOMB EXCITATION. van der Merwe, J. C.; Buitendag, J. J.; Naude, W. J.; Koen, J. W.; Hough, J. H.; van Heerden, I. J. 1972.

14063 FAST-NEUTRON CROSS SECTIONS OF NIOBIUM: MEASUREMENT AND EVALUATION. Guenther, P.; Whalen, J.; Smith A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 311-312(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14064 HALF-LIFE MEASUREMENTS OF EXCITED LEVELS IN ^{122}I. Lode, D. (Technische Univ., Brunswick); Muennich, F.; Hoeglund, A.; Malmskog, S. G. Nucl. Phys.; A209: No. 1, 170-180 (1973).

The half-lives of three low-lying levels in ^{122}I were measured using delayed coincidence techniques. The following results were obtained: $T_{\frac{1}{2}}$(61.8 keV) = 7.4 ± 0.5 ns, $T_{\frac{1}{2}}$(90.7 keV) = 1.9 ± 0.3 ns and T (146.8 keV) ≦ 80 ps. All transitions depopulating these levels are mainly of M1 multipolarity; they are hindered with factors up to 295 as compared to the single-particle estimates. (auth)

14065 RATIO OF THE NUCLEAR QUADRUPOLE MOMENTS OF ^{99}Ru BY MOESSBAUER SPECTROSCOPY. Gibbs, T. C.; Greatrex, R.; Greenwood, N. N.; Puxley, D. C.; Snowdon, K. G. (Univ. of Leeds, Eng.). Chemical Physics Letters; 20: No. 1, 130-132(1 May 1973).

The ratio of the nuclear quadrupole moments of the first excited and ground states of ^{99}Ru was determined for the first time. The value of Q_e/Q_g = +2.94 ± 0.04 was obtained from the quadrupole splitting observed in the ^{99}Ru Moessbauer spectrum of the spinel Co_2RuO_4. Consideration of the ligand-field splitting at the ruthenium site leads to the belief that Q_e and Q_g are both positive, and that $Q_e > 0.23 \times 10^{-28}$ m^2. (auth)

14066 DETERMINATION OF MIXING RATIOS FROM THE GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN A TRIPLE CASCADE. Chow, G. Y. (Saginaw Valley Coll., University Center, MI); Wiedenbeck, M. L. Nucl. Instrum. Methods; 109: No. 3, 597-599(1973).

Formulas for the determination of the three mixing ratios in a triple cascade were derived and expressed in terms of the directional correlation coefficients of $\gamma_1-\gamma_2$, $\gamma_2-\gamma_3$, and $\gamma_1-\gamma_3$ cascades. The proposed treatment does not employ the usual assumption of neglecting the small mixing in a particular gamma-ray transition. (3 figures) (auth)

14067 EFFECTIVE DECORRELATION OF ERRORS OF PHOTON DIFFERENCE DATA. Crawford, D. M.; Kock, R.; Thies, H. H. (Univ. of Western Australia, Nedlands). Nucl. Instrum. Methods; 109: No. 3, 573-577(1973).

The propagation of random errors of photonuclear yield data in a photon difference-type transformation generates cross-section errors, which are correlated. Methods are discussed which minimize the effects of this correlation and, hence, help to make the cross section interpretation straightforward and unambiguous. (1 figure, 3 tables) (auth)

14068 NEW ISOMERIC STATE IN ^{134}Pr AND EXCITED STATES OF ^{134}Ce. Arlt, R.; Beyer, G.; Fominykh, V.; Herrmann, E.; Jasinski, A.; Ortlepp, H. G.; Strusny, H.; Tyrroff, H.; Usmanova, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B4: No. 3, 301-310(1973).

Radioactive sources of ^{134}Pr and ^{134}Nd in equilibrium with the ^{134}Pr daughter obtained by spallation reaction were studied with Ge(Li) detectors. A new isomeric state was found in ^{134}Pr. Gamma–gamma coincidence were measured using two 25-cm^3 Ge(Li) detectors. On the basis of gamma intensities, energy sums, and coincidences information decay schemes are proposed for the isomeric and ground state of ^{134}Pr. (auth)

14069 TOTAL CROSS SECTIONS OF Y, Zr, La, Ce, Pr, Gd, Ho, Ta AND Hg FOR 1.0 TO 2.0 MeV NEUTRONS. Islam, E. (Dacca Univ., Bangladesh); Hussain, M.; Ameen, N.; Enayetullah, M.; Islam, N. Nucl. Phys.; A209: No. 1, 189-201(1973).

Total neutron cross sections of Y, Zr, La, Ce, Pr, Gd, Ho, Ta, and Hg were measured with a standard deviation of 2% or better for the energy range between 1.0 and 2.0 MeV in steps of 10 keV. The energy resolution of the data was 7 to 8 keV except for Pr, for which it was 18 keV. The measured cross sections were compared with other available data. The cross sections for some of the nuclei show large fluctuations. Average cross sections were compared with optical model results, and they showed a reasonable agreement. (4 figures, 1 table) (auth)

14070 FLUCTUATIONS IN THE TOTAL CROSS SECTIONS OF Y, Zr, La, Ce, Pr, Gd, Ho, Ta, AND Hg FOR 1.0 TO 2.0 MeV NEUTRONS. Islam, E.; Hussain, M. (Dacca Univ., Bangladesh). Nucl. Phys.; A209: No. 1, 202-220(1973).

Results of an analysis of the fluctuations observed in the neutron total cross sections of nine different nuclei in the energy range between 1.0 and 2.0 MeV are presented. It was found that in general these may be explained to be due to fluctuations in the widths and spacings of the compound-nucleus level. The cross section data for some of the nuclei seem to indicate the presence of structures with widths much larger than the compound-nucleus width. (11 figures, 1 table) (auth)

14071 MONTE CARLO SIMULATION OF THE DECAY OF NEUTRON RESONANCES TO DETERMINE RESONANCE SPINS. Namenson, A. I. (Naval Research Lab., Washington, DC). Nucl. Phys.; A209: No. 2, 252-270(1973).

The results for two types of experiments which measure the spins of neutron resonances are predicted by means of a Monte Carlo calculation which simulates the γ cascades following neutron capture. The results are compared with experiment wherever possible. For the method which compares the ratios of γ lines depopulating low-lying levels, the calculation is performed for ^{143}Nd, ^{145}Nd, ^{187}Os, and ^{189}Os. For the method which compares coincidence to singles counting rates, the calculation is performed for the four nuclei mentioned above plus ^{185}Re, ^{187}Re, and ^{177}Hf. The validity of the approximations and assumptions used in the calculation is discussed. Also discussed are proposed improvements in the experiments made on the basis of both experimental data and the calculation. All necessary derivations are given in the appendix. (3 figures, 3 tables) (auth)

14072 STUDY OF ^{93}Nb LEVELS POPULATED VIA THE (n,n'γ) REACTION. van Heerden, I. J. (Southern Universities Nuclear Inst., Faure, South Africa); MacMurray, W. R.; Saayman, R. Z. Phys.; 260: No. 1, 9-34(1973).

De-excitation γ-rays from levels in ^{93}Nb up to 2,203 keV were observed following inelastic neutron scattering at incident energies between 0.6 and 2.575 MeV. The energy levels and decay modes of ^{93}Nb are deduced. Spin and parity assignments are based on the comparison of the experimental (n,n') cross sections with calculated cross sections using Hauser–Feshbach theory corrected for level-width fluctuations. The low-lying levels of ^{93}Nb have been studied within the framework of the vibration–particle model to account for their energy and spin assignments, as well as the reduced transition probabilities measured in Coulomb excitation experiments. (8 figures, 5 tables) (auth)

14073 p-WAVE RESONANCES IN ^{111}Cd(n,γ)^{112}Cd. Wasson, O. A.; Allen, B. J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. C 7: No. 2, 780-787 (Feb 1973).

γ-ray spectra and total capture yields were measured for resonant neutron capture in an enriched ^{111}Cd sample for neutron energies less than 2.3 keV. The experiment utilized the 40-m flight path of the Oak Ridge electron linear accelerator and a nonhydrogeneous liquid-scintillator γ-ray detector. A total of 162 resonances were observed in this interval, and the resonance energies and neutron widths deduced. Approximately 14% of the resonances are assigned to p-wave capture on the basis of the γ-ray spectral measurements while an additional 23% are assigned to s-wave capture on the basis of their large neutron widths. The parity of the remainder is undetermined. A lower limit of 0.9×10^{-4} is observed for the p-wave neutron strength function $[\Sigma g\Gamma_n{}^1/(2I+1)\ \Delta E]$ while the s-wave neutron strength function $[\Sigma g\Gamma_n{}^0/\Delta E]$ is 0.15×10^{-4}. (auth)

14074 INVESTIGATION OF THE NONUNIQUE FIRST-FORBIDDEN β DECAY. II. ANALYSIS OF THE 7/2(0.581 MeV)5/2$^+$ β-TRANSITION IN ^{141}Ce. Civitarese, O.; Krmpotić, F. (Departamento de Fisica, Facultad de Ciencias Exactas, Universidad de La Plata, La Plata, Argentina); Cambiaggio, M. C.; Szybisz, L. Phys. Rev. C 7: No. 2, 768-773 (Feb 1973).

The β moments of the $7/2^-(\beta)5/2^+$ transition from the decay of Ce^{141} have been extracted from the experimental data. We have obtained the following results: $\langle i\vec{r}\rangle = 0.98 \pm 0.20$ fm, $\langle \vec{\sigma}\times\vec{r}\rangle = -1.11 \pm 0.35$ fm, $\langle iB_{ij}\rangle = 1.30 \pm 0.50$ fm and $\langle i\vec{\Sigma}\rangle/\xi_1 = 2.16 \pm 0.45$ fm. These results are consistent with the analysis of the $7/2^-(\beta)5/2^+$ transition in Ba^{139} and with the measurement of the γ moment $\langle i\vec{r}\rangle$ from the isobaric analog state of the ground state in Ce^{141} to the ground state in Pr^{141}. We present here a discussion concerning the polarizability effects due to the charge-exchange excitation modes. (auth)

14075 GAMMA-RAY STUDIES ON THE DECAY OF 2.41-MIN ^{108}Ag. Singhal, N. C.; Johnson, Noah R.; Eichler, E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37803); Hamilton, J. H. Phys. Rev. C 7: No. 2, 774-779 (Feb 1973).

γ-ray singles and coincidence measurements following the decay of 2.41-min ^{108}Ag have been performed with Ge(Li) and NaI(Tl) detectors. A total of 13 γ rays have been assigned to ^{108}Ag decay and their energies and intensities have been measured accurately. From the coincidence measurements and energy-sum relationships 12 γ rays have been fitted into six excited states of ^{108}Pd with the following energies in keV and spins: 433.96, 2$^+$; 931.09, 2$^+$; 1052.82, 0$^+$; 1314.22, 0$^+$; 1441.16, 2$^+$; and 1539.97, 1,2. The first excited 2$^+$ state of ^{108}Cd at 632.98 keV is also populated by the β decay of ^{108}Ag. The spins of the

1052.82- and 1314.22-keV levels were determined uniquely as 0 from the NaI(Tl) -Ge(Li) directional-correlation measurements. These data also yield a spin of 2 for the 1441.16-keV level and E2+ ≤2%M1 multipolarity for the 1007.22-keV transition. A discussion of the ^{108}Pd levels within the vibrational framework is presented. (auth)

14076 LEVEL STRUCTURE OF ^{92}Mo AND ^{94}Mo STUDIED WITH THE (p,t) REACTION. Larsen, J. S. (Niels Bohr Institute, Copenhagen, Denmark); Ball, J. B.; Fulmer, C. B. Phys. Rev. C 7: No. 2, 751-760 (Feb 1973).

The ^{94}Mo(p,t)^{92}Mo and ^{96}Mo(p,t)^{94}Mo reactions have been studied at an incident proton energy of 31 MeV. The triton spectra were obtained with a magnetic spectrograph with over-all resolution of about 20 keV. Experimental angular distributions are compared with two-nucleon-transfer distorted-wave Born-approximation calculations to extract spin-parity assignments and enhancement factors. Particular emphasis is placed on the study of the L=0 transitions near the closed shell at 50 neutrons. (auth)

14077 TIME-DIFFERENTIAL QUADRUPOLE INTERACTION OF ^{111}Cd NUCLEI IMPLANTED BY (α,2N) REACTIONS INTO A CUBIC Ag LATTICE. Behar, M.; Steffen, R. M. (Tandem Accelerator Laboratory, Purdue University, Lafayette, Indiana 47907). Phys. Rev. C 7: No. 2, 788-794 (Feb 1973).

The quadrupole interaction of ^{111}Cd ions following the decay of ^{111}In implanted by (α,2n) reactions into a cubic (fcc) Ag lattice has been measured with the time-differential perturbed-angular-correlation method. A nonvanishing quadrupole interaction corresponding to a distribution of electric field gradients was observed. The "smeared out" quadrupole interaction frequency has a centroid $\bar{\omega}$ from 2.04 to 1.50 MHz depending on the temperature and the time the irradiated Ag was allowed to "heal." In addition, about 3% of the ^{111}In-^{111}Cd ions experience a quadrupole interaction with a sharp frequency $\omega_Q = 157 \pm 2$ MHz. The temperature dependence of the healing process was investigated. At room temperature no further healing occurs after 6 days once the $\bar{\omega} = 1.50$ MHz was reached. Annealing for 12 hours at 600°C causes the quadrupole interaction to vanish completely. Various quadrupole-perturbation and "healing" mechanisms are discussed. The most likely cause of the quadrupole perturbation in the cubic Ag lattice are vacancies and/or Ag interstitials. (auth)

14078 FORKING OF GROUND STATE BANDS IN ^{102}Pd and ^{100}Pd. Scharff-Goldhaber, G.; Mckeown, M.; Lumpkin, A. H.; Piel, W. F. Jr. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 44B: No. 5, 416-420(28 May 1973).

A new phenomenon is observed in the level schemes of ^{102}Pd and ^{100}Pd, populated by heavy ion induced reactions: the ground state bands of these nuclei reach J = 14, but "fork" into two branches, at the 8+ state in ^{102}Pd and at the 6+ state in ^{100}Pd. A ground state band in the near-magic nucleus ^{98}Pd, whose level energies were previously unknown, was populated to J = 8. (auth)

14079 DESCRIPTION OF DECOUPLED BANDS USING THE ANGULAR MOMENTUM PROJECTION METHOD APPLIED TO THE COHERENT PHONON STATE. Ikeda, A. (Florida State Univ., Tallahassee); Sheline, R. K.; Onishi, N. Phys. Lett.; 44B: No. 5, 397-400(28 May 1973).

The decoupled bands of the odd-A La-isotopes are described by the angular momentum projection method. The coherent phonon state is assumed for the intrinsic wave function of the core. The present model covers the particle-vibrator and the particle-rotor coupling model. The results are in good agreement with the experimental energy spectra. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 13708, 14053, 14069–14071, 14093, 14099, and 14120.

14080 (JINR-P7-7168) REGULARITIES OF NUCLEAR PRODUCTION IN THE REACTIONS WITH Kr AND Xe IONS. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Nguyen Tak An; Nadkarni, D. M.; Gavrilov, K. A.; Kim De En; Yussomua, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The yields of the nuclear reaction products in the region 69 ≤ z ≤ 95 were studied when bombarding the ^{181}Ta, ^{197}Au and ^{238}U targets with ^{40}Ar, ^{84}Kr and ^{136}Xe ions. The obtained experimental data are analyzed from the point of view of two possible reaction mechanisms: multinucleon transfers and fission of a compound system. (auth)

14081 (SUNI-23, pp 12-13) ENERGY LEVELS AND TRANSITIONS IN ^{160}Gd FROM THE (n,n'γ) REACTION. Elbakr, S. A. (Univ. of Manitoba, Winnipeg); van Heerden, I. J.; Robertson, B. C.; McDonald, W. J.; Neilson, G. C.; Dawson, W. K. 1972.

14082 GROUND-STATE HYPERFINE STRUCTURE AND NUCLEAR MAGNETIC DIPOLE MOMENTS OF ^{177}Hf AND ^{179}Hf. Buettgenbach, S.; Herschel, M.; Meisel, G.; Schroedl, E.; Witte, W. (Univ., Bonn). Z. Phys.; 260: No. 2, 157-164(1973).

By using the atomic beam magnetic resonance method, the experimental hyperfine structure data of the $5d^26s^2\ ^3F_2$ ground state of ^{177}Hf and ^{179}Hf described in a previous paper [Z. Phys. 250: 57 (1972)] have been completed. After applying corrections due to perturbations by other fine structure levels of the configuration $5d^26s^2$, the multipole interaction constants A, B, C, and D were obtained. By measuring rf transitions at magnetic fields between 1100 and 1550 Gauss the nuclear ground state magnetic dipole moments were determined. (2 figures, 2 tables) (auth)

14083 K-ELECTRON CAPTURE PROBABILITIES IN THE DECAYS OF ^{151}Gd AND ^{159}Dy. Genz, H.; Wood, R. E.; Palms, J. M.; Venugopala Rao, P. (Emory Univ., Atlanta). Z. Phys.; 260: No. 1, 47-56(1973).

The K-electron capture probability, P_K, in the allowed and nonunique first-forbidden transitions is measured by observing coincidences between K x-rays and γ-rays. The following results are obtained: In ^{151}Gd decay P_K to the 349.8-keV level is 0.713 ± 0.015 and P_K to the 307.4-keV level is 0.813 ± 0.020. It is also deduced that the decay energy Q_{EC} is 491^{+4}_{-9} keV and the spin of the 307-keV level is 7/2. In ^{159}Dy decay P_K to the 58.0-keV level is found to be 0.803 ± 0.032. (5 figures) (auth)

14084 7.3-MS ISOMER OF ^{161}Lu. Anholt, R.; Rasmussen, J. O.; Rezanka, I. (Yale Univ., New Haven). Nucl. Phys.; A209: No. 1, 72-76(1973).

An isomer of ^{161}Lu with a half-life of 7.3 ± 0.4 ms was discovered in the heavy-ion reaction ^{148}Sm(^{19}F, 6n)^{161m}Lu. One γ-ray transition with energy 135.8 ± 0.2 keV was observed; and a K-conversion coefficient of 1.1 ± 0.3, deduced in the decay of this isomer. (auth)

14085 GROUND AND γ-VIBRATIONAL BANDS IN EVEN Os ISOTOPES (A = 182–188) STUDIED BY (α,xnγ) AND (p,xnγ) REACTIONS. Yamazaki, T. (Tokyo Univ.); Nishiyama, K.; Hendrie, D. L. Nucl. Phys.; A209: No. 1, 153-169(1973).

Gamma rays following ^{182}W(α,2n)^{184}Os, ^{184}W(α,2n)^{186}Os, ^{186}W(α,2n)^{188}Os, ^{185}Re(p,2n)^{184}Os, ^{185}Re(p,4n)^{182}Os, ^{187}Re(p,2n)^{186}Os, and ^{187}Re(p,4n)^{184}Os reactions were measured to study the ground and γ-vibrational bands in even Os isotopes (A = 182–188). In addition to the ground-state levels the γ-vibrational bands were identified up to the 5^+ members. The K = 4 band head is proposed in ^{186}Os and ^{188}Os. (15 figures, 4 tables) (auth)

14086 SHORT-RANGE CORRELATIONS, EFFECTIVE CHARGE, AND PARITY VIOLATION IN THE 482 keV TRANSITION IN TANTALUM. Missimer, J. (State Univ. of New York, Stony Brook); Jackson, A. D.; Fischbach, E. Contract AT(11-1)-3001. Nucl. Phys.; A209: No. 2, 221-232(1973).

A detailed investigation of the effect of the short-range correlations produced by the Reid soft-core potential on the one-vector-meson exchange contribution to the circular polarization of radiation emitted in the 482-keV transition in ^{181}Ta shows that the contribution is reduced by a factor of 2.5. Analysis reveals that the incorporation of effective charge in shell-model calculations results in unrealistically low estimates of the circular polarization. (2 figures, 5 tables) (auth)

14087 HIGH-SPIN ROTATIONAL STATES IN ^{171,173}Lu AND EVIDENCE FOR ΔK = 2 AND ΔK = 4 MIXINGS. Kemnitz, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Funke, L.; Kaun, K. H.; Sodan, H.; Winter, G.; Boznat, M. I. Nucl. Phys.; A209: No. 2, 271-300(1973).

The level schemes of the deformed odd-proton nuclei ^{171}Lu and ^{173}Lu were studied by in-beam spectroscopy. Measurements of singles γ-ray spectra, angular distributions, and γ–γ coincidences were performed in the ^{169}Tm(α,2nγ)^{171}Lu reaction at 27 MeV α-particle energy. In the reaction ^{173}Yb(d,2nγ)^{173}Lu singles spectra and γ–γ coincidences were measured. Additional γ-ray spectra were taken for the reactions ^{169}Tm(α,2nγ)^{171}Lu at E_α = 23 MeV and ^{173}Yb(p,nγ)^{173}Lu. The proposed level schemes of ^{171}Lu and ^{173}Lu involve rotational bands of the intrinsic states $7/2^+$[404], $1/2^+$[411], $1/2^+$[402], $1/2^-$[541], and $9/2^-$[514] up to spin $25/2$, $23/2$, $23/2$, $29/2$, and $21/2$, respectively, in ^{171}Lu and up to spin $23/2$, $17/2$, $13/2$, $25/2$, and $23/2$, respectively, in ^{173}Lu. Transitions between some states of the $1/2^+$[411] and $9/2^+$[402] bands in ^{171}Lu indicate a strong mixing of states with ΔK = 2. Similarly, a ΔK = 4 mixing between states of the $1/2^-$[541] and $9/2^-$[514] bands in ^{171}Lu is indicated by interband transitions. These mixings are described in terms of the rotation–particle coupling, considering only the interaction between states with K and K ± 1. The dependence of the side feeding to the $1/2^-$[541] and $7/2^+$[404] bands on the level spins and energies was investigated. (9 figures, 9 tables) (auth)

14088 PHOTONEUTRON PRODUCTION IN THICK TARGETS. Seltzer, S. M.; Berger, M. J. (National Bureau of Standards, Washington, D. C. 20234). Phys. Rev. C 7: No. 2, 858-861 (Feb 1973).

This paper reports new results on the yield of photoneutrons from thick targets bombarded with electron beams. Yields have been calculated for incident electron energies from 20 MeV down to the photonuclear cross section threshold, for tantalum and tungsten targets with thicknesses up to 12.5 g cm^{-2}. The increased yield from composite tungsten–beryllium targets has been explored. (auth)

14089 NEUTRON RESONANCE SPECTROSCOPY. XI. THE SEPARATED ISOTOPES OF Yb. Liou, H. I.; Camarda, H. S.; Hacken, G.; Rahn, F.; Rainwater, J.; (and others) (Columbia University, New York, New York 10027). Phys. Rev. C 7: No. 2, 823-839 (Feb 1973).

Neutron time-of-flight resonance spectroscopy results, using the Nevis synchrocyclotron, for the separated Yb isotopes (170, 171, 172, 173, 174, 176) are given. Transmission and self-indication measurements were made for several sample thicknesses of each isotope. Resonance parameters, Γ_n^0 (or $g\Gamma_n^0$), are given to ≈1.8 keV for 171 and 173, and to ≈10 keV for 172, 174, and 176. Levels in 170 were those seen in the natural element, but not in the 171–176 isotopes. Many resonances Γ_γ and J values were also obtained for 171 and 173, and a few Γ_γ values for 172 and 174. The $10^4 S_0$ values are 2.25 ± 1.0, 1.86 ± 0.16, 1.68 ± 0.20, 1.60 ± 0.28, 1.62 ± 0.21, and 2.29 ± 0.32 for 170, 171, 172, 173, 174, and 176, respectively. $\langle\Gamma_\gamma\rangle = 76.5$ meV (37 levels), 72.3 meV (3 levels), and 73.8 meV (33 levels) for 171, 172, and 173, respectively. A shape fit to the asymmetric level in 174 at 342.7 eV gave $R' = (7.9 \pm 0.5)$ Ffm. The increasing σ below ≈100 eV for 174 and natural Yb, and the known thermal 174 partial cross sections, were fitted assuming a bound 174 level at $E_0 = -25$ eV, $\Gamma_n^0 = 160$ meV. Comparison of the $(g\Gamma_n^0)^{1/2}$ distributions with Porter–Thomas theory and the nearest-neighbor energy spacings with the Wigner theory gave best agreement for 172, as did other statistical orthogonal ensemble (O.E.) tests. There are missing weak s levels for 171 and 173 and extra p levels for 176. The 174 and 176 results were also compatible with O.E. theory but provided poorer test cases than 172. (auth)

14090 MULTIPOLE MIXING RATIOS FOR SELECTED TRANSITIONS IN ^{154}Gd. Ober, D. R.; Weeber, W.; Place, R. L. (Department of Physics, Ball State University, Muncie, Indiana 47306). Phys. Rev. C 7: No. 2, 738-741 (Feb 1973).

γ–ray mixing ratios have been measured for four transitions in ^{154}Gd. The mixing ratios were obtained through the analysis of γ–ray angular correlations involving the transitions in question. All cascades had the 2^- octupole level at 1719.6 keV as the initial emitting state. A Ge(Li) –NaI(Tl) detector array was used to measure correlations for the following cascades: 592–1005 keV ($2^- \to 3^+_\gamma \to 2^+_{g.s.}$); 723–996 keV ($2^- \to 2^+_\gamma \to 0^+_{g.s.}$); 723–873 keV ($2^- \to 2^+_\gamma \to 2^+_{g.s.}$). A two–parameter [$\delta(\gamma_1)$, $\delta(\gamma_2)$] search routine was developed for the analysis of the correlations involving two mixed–multipole transitions. Results for the mixing ratios are: δ (592) $= 0.08^{+0.14}_{-0.22}$; δ (723) $= 0.04^{+0.02}_{-0.04}$; σ (873) $= -10.0^{+2.0}_{-4.0}$; δ (1005) $= -9.5^{+7}_{-4}$. (auth)

14091 RE-INVESTIGATION OF ^{166}Yb → ^{166}Tm DECAY. de Boer, F. W. N.; Goudsmit, P. F. A.; Meijer, B. J. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Z. Phys.; 260: No. 1, 75-80(1973).

The decay of ^{166}Yb has been investigated with high-resolution Ge(Li) detectors. The intensity of any γ ray other than that at 82.29 keV is less than 0.3 % per decay. The total decay energy w redetermined as Q = 215 $^{+11}_{-18}$ keV. An upper limit $F_W < 150$ was determined for the hindrance factor of the F-forbidden 82.29-keV transition. (2 figures, 1 table) (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 14010, 14045, 14057, 14066, 14067, 14069, 14070, 14080, 14103, 14129, 14143, 14146, and 14147.

14092 (COO-3122-4) BEHAVIOR OF THE PARTICLES TRANSFERRED IN THE ^{16}O + ^{197}Au AND ^{12}C + ^{197}Au REACTIONS. Eyal, Y.; Beg, K.; Logan, D.; Miller, J.; Zebelman, A. (Columbia Univ., New York. Dept. of Chemistry). Apr 1973. Contract AT(11-1)-3122. 53p. Dep. NTIS $4.75.

The reactions between ^{197}Au and 166-MeV ^{16}O, 135-MeV ^{16}O, and 125-MeV ^{12}C were investigated through the measurement of energy and angular distributions of emitted light particles ranging from Li to N, production cross sections of selected radioactive products ranging from ^{192}Au to ^{205}Po, and recoil ranges of a few of these radioactive products. From the results information can be obtained on the probability that the intermediate excited heavy nuclei produced by the transfer of energy and nucleons from the incident projectile to the heavy target de-excite in a manner consistent with statistical equilibration of the excitation energy. The course of the transfer reactions is qualitatively discussed in terms of the semiclassical deflection function for the reacting systems. (9 figures, 3 tables) (auth)

14093 PION REACTION CROSS SECTIONS AND NUCLEAR SIZES. Allardyce, B. W. (Rutherford High Energy Lab., Chilton, Eng.); Batty, C. J.; Baugh, D. J.; Friedman, E.; Heymann, G.; Cage, M. E.; Pyle, G. J.; Squier, G. T. A.; Clough, A. S.; Jackson, D. F.; Murugesu, S.; Rajaratnam, V. Nucl. Phys.; A209: No. 1, 1-51(1973).

Measurements were made of the reaction cross sections of π^- and π^+ mesons for the nuclei C, Ca, Ni, Sn, and Pb at beam momenta of 0.71, 0.84, 1.00, 1.36, 1.58, and 2.00 GeV/c. Additionally, measurements were made for Al, ^{120}Sn, Ho, and ^{208}Pb at momenta of 0.84, 1.00, 1.36, and 1.58 GeV/c. The ratio of π^- to π^+ reaction cross sections was analyzed in terms of neutron density distributions by using the Watson multiple-scattering theory. The effects of second-order contributions and of the various choices of wave equation were considered. It is found that the distributions of neutrons and protons in heavy nuclei must have very similar radial parameters. Good agreement was obtained between the measured and calculated values for the reaction cross sections, without any adjustment of parameters. (16 figures, 12 tables) (auth)

14094 MEASUREMENT AND INTERPRETATION OF ^{197}Au-(d,xnyp) EXCITATION FUNCTIONS IN THE ENERGY RANGE FROM 25 TO 86 MeV. Jahn, P.; Probst, H. J.; Djaloeis, A.; Davidson, W. F.; Mayer-Boericke, C. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A209: No. 2, 333-347(23 Jul 1973).

Excitation functions of the ^{197}Au(d,xn)$^{199-x}$Hg (x = 4, 6, 7, 8, and 9) and the ^{197}Au(d,pxn)$^{198-x}$Au (x = 0, 2, 4, and 6) reactions were measured using the stacked-foil technique. The experimental data were compared with the theoretical predictions of the equilibrium statistical model and the hybrid model. While the (d,pxn) excitation functions and the high energy "tails" of the (d,xn) excitation functions could not be reproduced by the equilibrium statistical model, the hybrid model gave good overall agreement with the experimental data. (8 figures, 2 tables) (auth)

14095 GAMMA DECAY OF PARTICLE-HOLE STATES IN ^{208}Bi. Ellegaard, C.; Barnes, P. D. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213); Canada, T. R. Phys. Rev. C 7: No. 2, 742-748 (Feb 1973).

The gamma decay of 11 states in ^{208}Bi populated in the ^{209}Bi(d,t)^{208}Bi reaction has been measured in a particle–gamma coincidence experiment. The resulting decay scheme allows probable J^π assignments to be made which are consistent with those obtained in earlier (d,t) and (^{3}He,d) studies. The experimental decay scheme is compared with that calculated with the wave functions of Kim and Rassmussen and of Kuo, and is found to be in reasonable agreement with both. (auth)

14096 QUASIELASTIC ELECTRON SCATTERING AND A GIANT COLLECTIVE STATE IN ^{209}Bi. Klawansky, S.; Isabelle, D.; Kendall, H. W.; Kerman, A. K. (Laboratory for Nuclear Science, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts). Phys. Rev. C 7: No. 2, 795-800 (Feb 1973).

Inelastic electron scattering from ^{209}Bi in the momentum transfer range q=150–300 MeV/c induces a broad, strong excitation at about 20 MeV which cannot be explained by shell-model quasielastic knockout calculations. The excitation form factor exhibits a diffraction pattern whose dependence on q is consistent with preliminary predictions for previously unobserved E0 or E2 giant collective modes in the ^{208}Pb region. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 12938, 14080, 14120, 14123, 14125, and 14714.

14097 (COO–2231-4) HIGH-ENERGY NEUTRONS PRODUCED BY 740-MeV PROTONS ON URANIUM. Madey, R.; Waterman, F. M. (Kent State Univ., Ohio (USA). Dept. of Physics). 1972. 8p. (CONF-720444-3). Dep. NTIS $3.00.

From meeting of the American Physical Society; Washington, District of Columbia, USA (24 Apr 1972).

In order to test the validity of calculations made for the development of an intense neutron source using protons for the LAMPF accelerator the neutron spectra at 50° from 20 to 500 MeV proton bombardment and at 130° from 5 to 140 MeV proton bombardment of a 30-cm thick uranium target was measured. (JFP)

14098 (COO-3058-34) LINEAR ACCELERATOR PROJECT. Progress Report, January 1, 1973–March 31, 1973. Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1973. Contract AT(11-1)-3058. 52p. Dep. NTIS $4.75.

The bulk of the report deals with neutron cross sections. Measurements were made on ^{239}Pu, ^{54}Fe, ^{61}Ni, ^{60}Ni, U, and Ta. The optical model was also studied in this connection. Other sections of the report discuss experimental and theoretical aspects of reactor physics and engineering and instrumentation development. (RWR)

For abstracts of individual sections see: 13977, 14099, and 14122.

14099 (COO-3058-34, pp 7-18) AVERAGE RESONANCE PARAMETERS OF DEPLETED URANIUM AND TANTALUM IN THE ENERGY RANGE 10 TO 100 keV. Byoun, T. Y.; Block, R. C.; Semler, T. 1973.

In linear accelerator project.

14100 (JINR-P7-7108) APPLICATION OF THE JACKSON-SIKKELAND METHOD IN CALCULATING THE PRODUCTION CROSS SECTIONS FOR SUPERHEAVY ELEMENTS. Il'inov, A. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possibilities of the semiempirical Jackson–Sikkeland method, used very often for calculation of the production cross sections for superheavy elements in heavy-ion-induced reactions, are studied. The method describes well the shape of the excitation function of the reaction with x-neutron emission; the absolute cross section values give the best agreement with experiment for the reaction with $x = 4.5$ (with an accuracy up to a factor of $k \approx 2$). This accuracy decreases when extrapolating to the region of new elements with $Z \geq 106$ and, in the first place, for the 5n-reaction. (auth)

14101 (KFK-1772) MEASUREMENT OF THE NEUTRON FISSION CROSS SECTION OF ^{235}U BETWEEN 0.5 AND 1.2 MeV. Kaeppeler, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Apr 1973. 81p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

Due to the importance of the ^{235}U fission cross section for reactor design as well as a secondary standard, an absolute measurement was performed between 0.5 and 1.2 MeV neutron energy. Using a fast pulsed neutron source for background discrimination and a new method for flux determination, the total uncertainty of seven absolute values could be reduced to about 3%. In addition twelve relative values allowed a detailed description of the cross section shape. Structure in the fission cross section at about 950 keV was found and is thought to be caused by the end of the energy gap in the compound nucleus ^{236}U. The resulting deformation dependence of the gap parameter Δ is discussed. (auth)

14102 (LA-UR-73-838) DEVELOPMENTS IN AREAS OF ON-LINE FISSION-YIELD AND DIRECT MASS MEASUREMENTS AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Balestrini, S. J.; Forman, L. (Los Alamos Scientific Lab., N. Mex.). 1973. 6p. (CONF-730618-4). Dep. NTIS $3.00.

From eighth international electromagnetic isotope separator conference; Skovde, Sweden (12 Jun 1973).

On-line studies of ^{238}U fission yields with fission-spectrum neutrons were made with the Bernas surface-ionization technique at the Godiva IV burst reactor facility. The target was 300 mg of ^{238}U in a porous graphite mixture. Ion emission rates were measured by Z-direction motion of the collector. The isotope collection time was varied from 0.1 to 4.0 seconds with respect to the reactor burst. Six sets of data gave the relative yields of Cs in the mass region 138 to 146. The absolute independent fission yields were obtained by normalization using radiochemical data and chain yield estimates. Work also progressed toward encapsulating the Bernas source in a thin graphite container to reduce the hazards of working with highly radioactive targets. Ion emission rate measurements on encapsulated ^{235}U indicated that the ~0.2-second ^{146}Cs is an accessible nuclide. The direct mass measurement section of the LAMPF on-line isotope separator proposal is being organized. The scope of this work and the participants and their institutions are reported. (1 figure, 1 table) (auth)

14103 (MLM-2042) DECAY AND GROWTH TABLES FOR THE NATURALLY OCCURRING RADIOACTIVE SERIES (REVISED). Kirby, H. W. (Mound Lab., Miamisburg, Ohio). 15 Jun 1973. Contract AT-33-1-GEN-53. 77p. Dep. NTIS $5.45.

Decay and growth tables published in 1954 were recomputed to take account of revisions in many of the half-life values of nuclides in the naturally occurring radioactive series. The tables include decay factors ranging over three orders of magnitude for each of four time units—minutes, hours, days, and years; Bateman equations for selected parents; growth factors for analytically significant daughters of those parents; and a working table of half-life quotients, which facilitates the evaluation of Bateman coefficients for parents other than those included in the tables. (101 tables) (auth)

14104 (ORNL-TM-4257) ADLER-III: A PROGRAM TO CALCULATE CROSS SECTIONS FROM ADLER–ADLER RESONANCE PARAMETERS. Wright, R. Q. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 31p. (ENDF-191). Dep. NTIS $3.75.

ADLER-III is a revision and extension of the ADLER program described in "ENDF/B Processing Codes for the Resonance Region," BNL-50296 (ENDF 148), by M. R. Bhat. The program calculates total, capture, and fission cross sections according to the Adler–Adler formalism using the corresponding parameters from file 2 of ENDF/B data. Doppler broadening is provided through the use of the ψ and φ functions. The program can read the resonance parameters from an ENDF/B tape (BCD mode), or the resonance parameters may be read from cards, if desired. (2 figures, 1 table) (auth)

14105 EMPIRICAL FORMULAS FOR TIME-DEPENDENT BETA SPECTRA FOR ^{235}U FISSION. Wehring, B. W. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 16: 60-61(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14106 ^{233}U FISSION-NEUTRON SPECTRUM FROM 0.8 TO 10 MeV. Green, L.; Mitchell, J. A. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 16: 312-315(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14107 FISSION-NEUTRON MULTIPLICITY AND TOTAL PROMPT GAMMA-RAY ENERGY FOLLOWING FISSION IN ^{239}Pu. Weston, L. W.; Todd, J. H. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 315(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14108 PROMPT NEUTRONS EMITTED IN SPONTANEOUS FISSION OF ^{257}Fm. Veeser, L. R.; Wilhelmy, J. B.; Hoffman, D. C.; Hemmendinger, A.; Ford, G. P.; Farrell, J. A.; Balagna, J. P. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 315-316(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14109 MEASUREMENT OF THE INTEGRAL FISSION CROSS SECTION OF ^{232}Th IN A ^{252}Cf FISSION-NEUTRON SPECTRUM. Deen, J. R.; Draper, E. L. Jr.; Chromik, J. J. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 16: 316-318(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14110 EVALUATION OF THE UNCERTAINTIES IN THE TOTAL RADIATION WIDTHS OF ^{238}U. Rahn, F. J.; Havens, W. W. Jr. (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 16: 318(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14111 MEASUREMENTS OF THE DOPPLER EFFECT IN THIN URANIUM METAL. Baughn, J.; Sher, R. (Stanford Univ., CA). Trans. Amer. Nucl. Soc.; 16: 318-319(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14112 ELECTROFISSION OF ^{238}U. Shotter, A. C. (Univ. of Edinburgh); Reid, J. M.; McCann, M. F. J. Phys., A (London); 6: No. 6, 874-877(Jun 1973).

A measurement using surface barrier layer detectors of the kinetic energy of fission fragments from ^{238}U bombarded by 70-MeV electrons was used to find the relative yield and the total kinetic energy released as a function of the ratio of the fragment masses. (auth)

14113 PERTURBATION OF $\alpha-\gamma$ ANGULAR CORRELATION IN A POLYCRYSTALLINE ^{241}Am SOURCE. Chauhan, S. D.; Garg, R. K.; Gupta, S. L.; Saha, N. K. (Univ. of Delhi). J. Phys., A (London); 6: No. 6, 867-873(Jun 1973).

Perturbation studies of the $\alpha-\gamma$ angular correlation for the (5486α) (59.6γ) $(\frac{5}{2}^- - \frac{5}{2}^- - \frac{5}{2}^+)$ cascade have been carried out in a polycrystalline ^{241}Am sample using the time-differential technique. The exponential trend of the angular correlation coefficients $A_2(\bar{t})$ as a function of the mean time delay $\bar{t}$ shows a strong time-dependent behavior of the interaction phenomena. This is consistent with the theory of Abragam and Pound (Phys. Rev.; 92: 943-62 (1953)) for polycrystalline sources. The value of the relaxation

constant λ_2, characteristic of the time-dependent perturbation, is found to be $\lambda_2 = (1.81 \pm 0.17) \times 10^9\ s^{-1}$. The time-integrated perturbation coefficient obtained is $\overline{G}_2(\bar{t} = 2.4\ ns) = 0.19 \pm 0.01$. By using the experimental λ_2 value, the spin-relaxation time τ_s for the 5f electron shell is calculated as $\tau_s = (1.56 \pm 0.63) \times 10^{-11}$ s. The validity of the condition $\omega_s \tau_s \ll 1$ in the present case strongly suggests that the time-dependent character of the angular correlation is carried primarily by magnetic interactions between the unfilled 5f electron shell of ^{237}Np and the magnetic moment of the nucleus and, secondarily, by electron excitation of the Np atom. (auth)

14114 LEVELS OF ^{234}U AND ^{236}U EXCITED BY THE (d,d') REACTION. Boyno, J. S. (Michigan State Univ., East Lansing); Huizenga, J. R.; Elze, T. W.; Bemis, C. E. Jr. Nucl. Phys.; A209: No. 1, 125-134(1973).

The energy levels of ^{234}U and ^{236}U were studied through the inelastic scattering of 16-MeV deuterons. A magnetic spectrograph was used to momentum-analyze the scattered deuterons at $\theta = 90°$ and 125°. Excited in both ^{234}U and ^{236}U were the ground-state bands up to and including the 8^+ members, the $K^\pi = 0^+$ β vibrations, the $K^\pi = 2^+$ γ vibrations, and the $K^\pi = 0^-$ octupole vibrational bands. In ^{234}U, additional levels at 1023 and 1126 keV are ascribed to a $K^\pi = 2^-$ band, levels at 1238, 1312, and 1446 keV are identified as members of either a $K^\pi = 0^-$ or 1^- configuration, and other tentative assignments are made for members of $K^\pi = 1^-$ and 3^- configurations. Relative reduced transition probabilities, B(E2), to the 2^+ rotational and γ- vibrational states are generally found to be in good agreement with Coulomb excitation measurements. Relative B(E3) values for the 3^- states excited are slightly higher than the predictions of a microscopic theory of octupole vibrations. (2 figures, 5 tables) (auth)

14115 EXCITATION ENERGY CORRELATIONS IN SPONTANEOUS FISSION OF CALIFORNIUM 252. Gavron, A. Rehovoth, Israel; Weizmann Institute of Science (1972). 74p. (In Hebrew). Thesis.

The kinetics of the excitation energy distribution in the fission of ^{252}Cf is probed by determining the width of the distribution in each of the fragments and the correlation between the two distributions. Measurements were carried out of two neutrons emitted by the same fragment and of two neutrons one of which was emitted by the complementary fragment. Results are compared with the scarce information available elsewhere. The results were analyzed in terms of a statistical model; the model assumes that the neutron distributions in the two fragments and their correlation can be described as the sum of two effects—one which produces a correlation coefficient of ρ of +1, the other which produces a correlation coefficient of −1. It was found that when the covariance μ is close to zero both effects are of equal magnitude. (auth)

14116 FISSION BARRIERS DEDUCED FROM THE ANALYSIS OF FISSION ISOMER RESULTS. Britt, H. C.; Bolsterli, M.; Nix, J. R.; Norton, J. L. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. C 7: No. 2, 801-823 (Feb 1973).

Available experimental data on fission-isomer excitation functions have been reanalyzed using an improved statistical model to determine values for the energies relative to the ground state of the secondary minimum and second maximum in the fission barrier for a series of plutonium, americium, and curium isotopes. The statistical model incorporates realistic decay-width calculations for neutron emission, fission, and γ-ray emission which are based on nuclear level densities derived from appropriate single-particle-level spectra. Values for the curvature $\hbar\omega_B$ of the second barrier are also estimated from the observed fission-isomer half-lives. The fission-barrier shapes determined from the analysis of experimental results are compared to theoretical calculations of barriers performed by several groups. The experimental barrier parameters agree with a variety of theoretical calculations to an accuracy of about 1 MeV. Systematic deviations between the experimental and theoretical results suggest that the surface asymmetry constant κ in the liquid-drop mass formula should be substantially larger than the value of 1.7826 used in the second mass formula of Myers and Swiatecki. (auth)

14117 PERTURBED $\alpha\gamma$-ANGULAR CORRELATIONS IN THE DECAY OF ^{228}Th. Herzog, P.; Krien, K.; Freitag, K. (Univ., Bonn). Z. Phys.; 260: No. 1, 57-66(1973).

At external magnetic fields between 1.3 and 22.5 kG the integral $\alpha\gamma$-angular correlations of the $0^+(\alpha)2^+(\gamma)0^+$ cascades from the ground states of ^{228}Th and ^{224}Ra implanted into iron and aluminum lattices have been studied. The data were analyzed assuming different additional time-dependent and static perturbations. The rotation of the angular correlation for Ra in Al proved independent of these assumptions. Therefore, a g-factor of the 84.4-keV 2^+ state in ^{224}Ra, g = 0.46(11), could be derived. The hyperfine fields experienced by Ra and Rn in Fe were derived using Abragam and Pound theory to be H_{HF} (Ra Fe) = −127(31) kG and H_{HF} (Rn Fe) = 1,095 kG. (auth)

14118 TERNARY FISSION INDUCED BY HIGH ENERGY PROTONS. de Carvalho, H. G.; Schechter, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo Cim.; 16A: No. 1, 102-110(1 Jul 1973).

Uranium was irradiated with high-energy protons: 600 MeV, 2.9 GeV, 12.3 GeV and 21.8 GeV. Through the use of nuclear emulsions as detectors, three-prong events with cross sections of (1.2 ± 0.1) mb, (2.2 ± 0.1) mb, (4.8 ± 0.8) mb and (6.5 ± 1.2) mb, respectively, were found, along with the usual fission tracks. The results show that as well as a true ternary fission process, a variety of other phenomena exist which can produce three-prong events and must be taken carefully into account. (auth)

14119 CALCULATION OF THE PROPERTIES OF QUADRUPOLE VIBRATIONAL STATES FOR SHAPE ISOMERS. Zielinska-Pfabe, M. (Inst. of Nuclear Research, Warsaw, Poland). Phys. Lett.; 44B: No. 5, 405-408(28 May 1973).

Properties of the quadrupole vibrational β and γ states are studied for the spontaneously fissioning even-even shape isomers. Calculations are done in the quasiboson approximation with the use of single particle Nilsson potential. (auth)

Nuclear Theory

Refer also to abstracts 13643, 13825, 13830, 14029, and 14098.

14120 (COO-3001-40) NEW APPROACH TO DEFORMATION ENERGY CALCULATIONS. Ko, C. M.; Pauli, H. C.; Brack, M.; Brown, G. E. (State Univ. of New York, Stony Brook. Dept. of Physics). 1973. 13p. Dep. NTIS $3.00.

A simplified microscopic method is used to calculate the deformation energy curves of heavy nuclei, which show a second minimum and two fission barriers at about the same deformations as in the shell-correction calculations. (2 figures, 1 table) (auth)

14121 (COO-3001-41) ELECTRIC-DIPOLE SUM RULE AND TWO-BODY CORRELATIONS IN NUCLEI. Weng, W. T.; Kuo, T. T. S.; Brown, G. E. (State Univ. of New York, Stony Brook. Dept. of Physics). 1973. Contract AT(11-1)-3001. 20p. Dep. NTIS $3.00.

The enhancement factor, K, in the electric dipole sum rule is calculated using the linked diagram perturbation theory for the effective operator and the Reid nucleon-nucleon potential. Results are in good agreement with the recent experimental values for ^{16}O and ^{40}Ca; namely, K is around 1.0. There is, however, a large discrepancy between theory and experiment for ^{4}He. The two-body correlations, especially those induced by the tensor force, are found to be extremely important for the enhancement factor. (4 figures, 2 tables) (auth)

14122 (COO-3058-34, pp 23-30) ANGULAR MOMENTUM DEPENDENT OPTICAL MODEL FOR NONSPHERICAL NUCLEI. Turinsky, P. J.; Sierra, J. 1973.

In linear accelerator project.

14123 (COO-3496-27) THRESHOLD PHOTOFISSION: THEORY AND EXPERIMENT. Huizenga, J. R.; Britt, H. C. (Rochester Univ., N. Y. Nuclear Structure Research Lab.). Mar 1973. 29p. (CONF-730301-9; UR-NSRL-69). Dep. NTIS $3.50.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

Theoretical expressions are presented for photofission of even-even targets induced with dipole and quadrupole photons. Experimental measurements of near-barrier photofission cross sections and angular distributions induced with bremsstrahlung and monoenergetic gamma rays are theoretically analyzed in order to characterize barrier transition states. The experimental data indicate that the K = 0+ and K = 0− barriers are nearly degenerate at the outer barrier, while the K = 0− barrier is approximately 0.7 MeV higher at the inner barrier. The observed probabilities for the fission of ^{232}Th and ^{238}U induced by photons and the (t,pf) reaction are shown to be similar. The quadrupole-to-dipole absorption ratio for heavy elements is estimated to be 0.04 ± 0.02. (7 figures) (auth)

14124 (IPNO-71-9) ESTABLISHMENT OF THE EXISTENCE OF SUPERSOFT NUCLEI. Foucher, R. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). Dec 1971. 7p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Supersoft nuclei are presented as a mixture of nuclear phases. The discovery of the existence of such nuclei in the heavy nucleus region is recalled and the interest of supersoft nuclei existing far from the stability zones is discussed. (FR)

14125 (JINR-P1-7115) NEUTRON SPECTRA FROM THE REACTIONS OF ABSORPTION OF NEGATIVE MUONS BY HEAVY NUCLEI AND THE RESONANCE MODEL OF NUCLEAR REACTIONS. Evseev, V. S.; Mamedov, T. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Neutron energy spectra from the nuclear absorption of μ^- mesons in ^{127}I and ^{232}Th were measured in the energy range $1.6 \leq E_n \leq 9.6$ MeV. By the low-energy part of the spectrum there were determined the "temperature" values of nucleus, T, produced after emission of the first neutron (1.28-0.05 MeV and 1.46-0.06 MeV for ^{126}Te and ^{231}Ac, respectively) and the density parameters of energy levels, α, of this nucleus. The comparison of the data on μ^- capture with the statistical model predictions shows that this model does not describe the decay process of the quasi-stationary states of an intermediate nucleus. As such states are of small-particle character (in correspondence with the resonance model of nuclear reactions), one has to assume they do not change their nature as far as neutron decay even in the heaviest nuclei. (5 figures, 1 table) (auth)

14126 (JINR-P4-7144) CONSTRUCTION OF COLLECTIVE HAMILTONIAN IN MICROSCOPIC NUCLEAR MODEL. Dzholos, R. V.; Denau, F.; Jansen, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

Based on the microscopic nuclear model Hamiltonian with an arbitrary residual interaction, the Hamiltonian describing the collective quadrupole excitations is constructed. An expression is obtained and analyzed for the potential deformation energy. The energies of the lowest collective states are calculated for the case when potential energy has two minima. (3 figures) (auth)

14127 (JINR-P7-7165) FORMATION AND DECAY OF COMPOUND NUCLEI IN THE HEAVY ION INDUCED REACTIONS. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 82p. (In Russian). Dep. NTIS (U. S. Sales Only) $6.25.

A statistical model of heavy-ion nuclear reactions passing through compound nucleus formation and decay is considered. Competition of the fission and evaporation processes is discussed. The accuracy is estimated, and the boundaries of statistical-model applicability are elucidated by comparison with experiment. Further development of statistical theory demands more detailed consideration of the process of heavy-ion fusion and the taking into account of the dependence of the fission barriers and the density level parameters on the excitation energy and other characteristics of the decaying nucleus. It is necessary also to take into account the contributions of noncompound processes. (31 figures, 4 tables) (auth)

14128 (RLO-1388-654) THEORETICAL NUCLEAR PHYSICS PROGRAM B. Progress Report, October 1, 1972-September 30, 1973. (Washington Univ., Seattle. Dept. of Physics). 1973. Contract AT(45-1)-1388. 37p. Dep. NTIS $4.00.

Very brief reports are given on activities in theoretical research between May 1972 and May 1973, along with proposed activities for the near future. The work is grouped under the following headings: nuclear reactions, nuclear structure and symmetries; quantum statistical mechanics and the many-body problem; field theory and elementary particles; atomic and molecular physics; general theory; and astrophysics. (RWR)

14129 COLLECTIVE CONTRIBUTION TO THE SPREADING WIDTH OF ISOBARIC ANALOG RESONANCES. Auerbach, N. (Tel-Aviv Univ., Israel). Phys. Lett.; 44B: No. 3, 241-244(30 Apr 1973).

The influence of the collective isovector monopole on the coupling of the isobaric analog state to the continuum is examined. It is shown that, when the monopole state is included in the calculation, the spreading width, resulting from this coupling, is reduced 2 to 4 times. (auth)

14130 MICROSCOPIC THEORY OF THE SO-CALLED TWO-PHONON STATES IN EVEN-EVEN NUCLEI. I. Basic Ideas. Kanesaki, N. (Kyushu Univ.); Marumori, T.; Sakata, F.; Takada, K. Progr. Theor. Phys. (Kyoto); 49: No. 1, 181-205(Jan 1973).

A new microscopic theory of describing the so-called "two-phonon" states in even-even nuclei, within the framework of the quasi-particle-new-Tamm-Dancoff method (including the ground-state correlations) is proposed. The theory can clearly overcome the well known difficulties of the higher-random-phase approximation (HRPA), which have so far arrested the further development of the essential merit of the HRPA superior to the boson expansion method. In addition, the spurious-state difficulty (due to the nucleon-number nonconservation of the quasi-particle representation) does not arise at all in the theory. It is not the purpose to present a clear-cut formulation of the theory, but rather to put an emphasis on the explanation of the basic idea. (auth)

14131 RELATIVISTIC QUANTUM FIELD THEORY AND THE HARTREE-FOCK METHOD. Da Providencia, J. (Univ., Coimbra). Nucl. Phys., B57: No. 2, 536-542(1973).

The possibility of applying non-perturbative approximation techniques, which have been developed for non-relativistic situations, to relativistic quantum field theoretic problems, is considered. The nuclear force problem is discussed. (auth)

14132 APPROXIMATE METHOD OF CALCULATION OF INTERACTION OF FAST IONS WITH NUCLEI. Barashenkov, V. S.; Gavrilov, E. G.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Moscow). Acta Phys. Pol.; B4: No. 3, 353-356(1973). (In Russian).

The formulas of the Glauber theory for collisions of two nuclei are expressed in terms of amplitudes of nucleon-nucleus interaction. Such an approach may be applied for the description of collisions of nuclei with considerable difference in size in the energy range > (200 to 300) MeV per nucleon of incident nucleus. The propagation of fast alpha-particles in photographic emulsion is calculated. (auth)

14133 INCREASED TRANSPARENCY OF NUCLEAR MATTER IN DIFFRACTIVE DISSOCIATION. Kamal, A. N.; Chavda, L. K. (Univ. of Alberta, Edmonton). Nucl. Phys.; B57: No. 2, 617-628 (1973).

A model is considered where an incident particle (photon or pion) diffractively dissociates into resonating systems or perhaps kinematic enhancements (ρ^0, A_1, etc.) in the nucleus. This system then propagates through the nucleus being absorbed via the optical potential but also makes transitions to other channels. It is shown that the transparency of the nuclear matter to the diffractively dissociated system increases in the presence of interchannel couplings provided the interchannel potentials are purely imaginary. (auth)

14134 ABSORPTION MECHANISM OF PIONS AND NUCLEAR CORRELATION. Futami, Y. (Science Univ. of Tokyo); Hiramoto, T. Progr. Theor. Phys. (Kyoto); 49: No. 2, 524-530(Feb 1973).

The absorption mechanism of pions on nucleon pairs in a nucleus are studied from a more fundamental point of view. The importance of nuclear correlation is emphasized. The effective absorption operator taking into account the final state interaction is introduced. (auth)

14135 EFFECT OF THE $\Delta(1236)$ IN NUCLEAR MATTER. Green, A. M.; Dahlblom, T. K.; Kouki, T. (Univ. of Helsinki). Nucl. Phys.; A209: No. 1, 52-58(1973).

The three main corrections to the binding energy of nuclear matter that involve the $\Delta(1236)$ are calculated with exchange effects and realistic correlation functions. It is found that their net effect at $k_F = 1.36$ fm^{-1} is small, but that their k_F dependence has a considerable effect on the saturation density. (6 figures, 5 tables) (auth)

14136 t-dn VERTEX FUNCTION AND THE (t,d) REACTION. Goldfarb, L. J. B.; Gonzalez, J. A.; Phillips, A. C. (Univ. of Manchester, Eng.). Nucl. Phys.; A209: No. 1, 77-90(1973).

Estimates are made of the t-dn vertex function, which is proportional to D^2, a multiplicative factor appearing in the differential cross section for (t,d) reactions at sub-Coulomb energies. The factor D^2 is calculated by using various triton internal wave functions and also by using dispersion relations for d-n scattering. Calculations also are made of the ^{3}He-dp vertex functions, as well as the factor D_0^2, which appears in the differential cross sections at higher energies. (auth)

14137 FINITE-RANGE CALCULATION OF THE TWO-NUCLEON TRANSFER REACTION. Lin, C. L.; Yamaji, S.; Yoshida, H. (Taiwan Univ., Taipei). Nucl. Phys.; A209: No. 1, 135-152(1973).

The DWBA treatment of the two-nucleon transfer reaction is studied here from several points of view. The perturbation interactions considered are a finite-range cluster-cluster interaction and a sum of finite-range nucleon-nucleon interactions, both of which have a Gaussian form. The differential cross section and form factor for the reaction $^{12}C(^3He,p)^{14}N$ are calculated using these interactions and compared. The dependence of the cross section on the interaction range as well as on the size parameter of the projectile is also discussed. (8 figures, 2 tables) (auth)

14138 BOSON DESCRIPTION OF COLLECTIVE STATES. II. Description of Odd Vibrational Nuclei. Doenau, F.; Janssen, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A209: No. 1, 109-124(1973).

By addition of the so-called ideal quasi particle to the boson space one can represent the odd-fermion states in that product space. In such a way one finds various representations of the

fermion operators in terms of the boson operators and ideal quasi particles. From these boson expansions of the fermion operators a finite one is selected by considering nonunitary transformations. Thus, the direct generalization of the Dyson representation for even systems is given for the case of odd systems. The Hamiltonian can be divided into three parts: the boson term which describes the vibrational motion of the even core, the unperturbed motion of the quasi particle, and the interaction between the quasi particle and the bosons. This interaction consists of two terms, one of which agrees with the term used by Kisslinger and Sorensen [Rev. Mod. Phys.. 35: 853 (1963)], which is usually called the dynamical interaction, and the additional term due to the anti-symmetrization between the extra particle and the even core. The latter term can be identified as the kinematical interaction, which is responsible for the anomalous coupling states. For example, it is demonstrated that this term produces qualitatively the same splitting of the one-phonon multiplet as was obtained by Kuriyama, et al., for the j shell. Furthermore, it is shown for the more complicated case of ^{117}Sn that the effect of this additional interaction between phonons and quasi particle is important when many shells to the states in the odd nucleus are taken into account. (4 figures) (auth)

14139 THEORY OF THREE-NUCLEON SYSTEMS. Kim, Y. E. (Purdue Univ., Lafayette, IN). New Phys. (S. Korea); 12: No. 3, 105-110(Sep 1972).

Recent developments in the theory of three-nucleon systems are briefly reviewed with emphasis on trinucleon bound-state problems. Trinucleon bound-state properties calculated from an "exact" solution of the complete set of the Faddeev equations are discussed. These include the electromagnetic form factors, the one-pion-exchange contribution to the axial-vector matrix element for the triton beta decay, the contributions of meson-exchange currents to trinucleon magnetic moments, and the deuteron-exchange form factor in proton-^{3}He elastic scattering. The variation of the trinucleon binding energy and electromagnetic form factors with phase-equivalent nucleon-nucleon interactions is also discussed. (auth)

14140 STRONG-ABSORPTION MODEL FOR SCATTERING OF PROTONS. Sen Gupta, H. M. (Univ., Dacca, Bangladesh); Karim, C. S.; Rahman, M.; Rahim, H. Z. Nuovo Cim.; 15A: No. 4, 751-766 (21 Jun 1973).

The 4-parameter strong-absorption model of Frahn and Venter is used to study the scattering of (17 to 50) MeV protons. A consistent set of strong-absorption model parameter values were obtained that gave a simultaneously satisfactory account of elastic scattering, polarization, and inelastic scattering. Data at forward angles are reasonably well reproduced; all observed features in polarization are given by the formalism and deformation parameters obtained from inelastic-scattering data are in excellent agreement with previous works. (auth)

14141 MODEL SPACE CALCULATION OF THE QUASI-PARTICLE INTERACTION IN NUCLEAR MATTER. Sjoeberg, O. (NORDITA, Copenhagen). Nucl. Phys.; A209: No. 2, 363-372 (1973).

Landau's Fermi liquid parameters, and physical quantities related to these, are calculated in nuclear matter by a model-space approach. The interaction induced by the polarization of the medium around a quasi particle is accounted for by applying the technique of Babu and Brown. The main result of the calculation is that the introduction of a model space does not appreciably change the quasi particle effective mass. For the effective mass, m*, the symmetry energy, β, and the compression modulus, K, values of 0.74 m, 38.4 MeV, and 208 MeV, respectively, were found. (10 figures, 1 table) (auth)

14142 CORRELATION EFFECTS IN THE THEORY OF ELECTRON SCATTERING BY NUCLEI. Kabacnik, N. M. (Moscow State Univ.). Cesk. Cas. Fys.; A23: No. 3, 235-249 (1973). (In Czech).

The influence of the nucleon–nucleon correlations on the high energy electron scattering by atomic nuclei in different regions of the spectrum is discussed. The elastic scattering and the effects of the short-range correlations are considered. Excitation of giant electric and magnetic resonances in inelastic electron scattering was investigated. The influence of the continuous spectrum on the formation of the giant resonance and its excitation by electrons are discussed. Finally, collective aspects of the theory of quasi-elastic electron scattering are examined. In all the cases considered the correlation effects proved to be considerable; they substantially change and even determine the behavior of the scattering cross sections. (auth)

14143 ACCURACY OF SEMICLASSICAL APPROXIMATIONS IN EXTRACTING SPECTROSCOPIC INFORMATION FROM DIRECT TRANSFER REACTIONS. Rihan, T. H. (Univ. of Libya, Tripoli). Nucl. Phys., A209: No. 2, 419-423(1973).

The diffraction-model amplitude for transfer reactions, previously developed by the author, is extended to energies below the Coulomb barrier. In this way, the spectroscopic factors for various transitions in the reaction ^{208}Pb(d,p)^{209}Pb are extracted. Comparison is made between these results and the predictions of the zero-range DWBA treatment, and good agreement is obtained. The observed cross sections at $\theta_L = 135°$ for various incident energies are also correctly reproduced within this treatment. (2 tables) (auth)

14144 COMPARISON OF SHORT-RANGE CORRELATION AND DISTORTION EFFECTS IN QUASIELASTIC ELECTRON SCATTERING. Hofmann, H. M. (Univ., Erlangen Nuernberg, Ger.). Nucl. Phys.; A209: No. 2, 233-244(1973).

The cross section for the (e,e'p) reaction is calculated in a single-particle model, taking into account simultaneously both the effects of short-range correlations and of the distortion of the outgoing nucleon due to its interaction with the residual nucleus. It is shown that for large recoil momenta ($q_R \geq 300$ MeV/c) the effects of distortions are dominated by the effects of correlations, provided the outgoing nucleon is described by a realistic optical potential. (6 figures) (auth)

14145 DWBA WITH CHARGE EXCHANGE AND ISOSPIN. Cotanch, S.; Robson, D. (Florida State Univ., Tallahassee). Nucl. Phys.; A209: No. 2, 301-322(1973).

The DWBA theory is examined under the assumption that both the form factors and distorted waves are functions of isospin. The formalism is developed and presented in both the coupled (isospin) and uncoupled (neutron–proton) representations. Applications are made in the areas of inelastic scattering and rearrangement phenomena. A model involving the $t \cdot T$ operator and the conservation of isospin for the strong interaction is introduced. The relation between this model and antisymmetry is discussed. A set of generalized Lane equations, the solutions of which describe both elastic and quasi-elastic scattering, is derived. This approach allows the charge-exchange process to be incorporated into the transition amplitude explicitly. Numerical calculations are performed and partial success is attained in explaining certain spectroscopic anomalies deduced previously by conventional theory. (auth)

14146 INVESTIGATION OF THE NONUNIQUE FIRST-FORBIDDEN β DECAY. I. ANALYSIS OF THE 2-(0.962 MeV)2 + β TRANSITION IN ^{198}Au. Bosch, H. E.; Cambiaggio, M. C.; Szybisz, L. (Departamento de Fisica, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, and Laboratorio de Radiaciones, Buenos Aires Argentina); Krmpotic, F.; Navaza, J. Phys. Rev. C 7: No. 2, 760-768 (Feb 1973).

A detailed study of the 0.962-MeV β transition from the decay of ^{198}Au is performed. A complete description of the theoretical formalism employed is given. Two sets of nuclear matrix elements have been extracted from the experimental data. In one of them the β moment of multipolarity $\lambda=2$ is of the same order of magnitude as those of multipolarities $\lambda=0$ and $\lambda=1$ and the ratio Λ ($=\langle\vec{\alpha}\rangle/\xi\langle\vec{r}\rangle$) is consistent with the Fujita–Eichler estimate [Λ (FE) $=2.4$]. In the second case the β moment of $\lambda=2$ is negligible and the ratio Λ is strongly reduced with respect to Λ (FE). A possible mechanism for the reduction of the β moments from their single-particle values is discussed on the basis of a particle–plus–phonon coupling model. It is concluded that the state $2f_{5/2}$ is the dominant neutron single-particle configuration in the ground state of ^{198}Au. (auth)

14147 GAMMA DECAY OF A NEUTRON DOORWAY RESONANCE. Beres, William P. (Wayne State University, Detroit, Michigan 48202); Divadeenam, M. Phys. Rev. C 7: No. 2, 862-864 (Feb 1973).

Small admixtures of doorways $|d'\rangle$ in with the dominant doorway $|d\rangle$ are shown to account for the possibility of γ decay from the neutron fine structure associated with the doorway $|d\rangle$. The example of low-lying $1/2^+$ resonances in ^{207}Pb is investigated via the particle–vibration model with the important doorway $|d'\rangle$ for E1 γ decay found to be that based on the 1 giant dipole resonance in ^{208}Pb. (auth)

14148 ELASTIC SCATTERING OF NUCLEONS FROM CORRELATED NUCLEI. Shakin, C. M.; Thaler, R. M. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). Phys. Rev. C 7: No. 2, 494-511 (Feb 1973).

A theory of the optical potential for scattering of nucleons from nuclei is presented. A development appropriate for intermediate- and high-energy scattering is given in this paper. For low energies the theory provides the leading term of the optical potential which must then be supplemented by the target. Particular attention is paid to the Pauli principle, and it is shown how standard multiple-scattering theories must be modified if the projectile is identical to the target particles. The development proceeds in the spirit of the many-body theory of finite nuclei, but deals with the problem of the addition of a (continuum) nucleon to an already

known strongly correlated nuclear state. The manner in which the correlations between target and projectile nucleons develop is explicitly displayed. It is the consideration of this additional two-body correlations which allows us to introduce the Bethe–Goldstone type of reaction matrices for the scattering problem. (auth)

14149 SIEGERT'S THEOREM AND INTERACTION CONTRIBUTIONS TO PARITY-VIOLATING ELECTROMAGNETIC TRANSITIONS IN NUCLEI. Gari, M.; Huffman, A. H. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. C 7: No. 2, 531-537 (Feb 1973).

The importance of the electromagnetic interaction currents in parity-nonconserving transitions is discussed together with the extension of the Siegert Theorem to the parity-nonconserving case. The Siegert Theorem is not valid beyond the static limit, and we show that besides this question of validity, it cannot be applied in the usual form if wave functions are used which are calculated through a perturbation series. (auth)

14150 OPTIMAL NUCLEAR SINGLE-PARTICLE POTENTIAL. Brueckner, K. A.; Meldner, H. W. (Institute of Pure and Applied Physical Sciences, and Department of Physics, University of California at San Diego, La Jolla, California 92037); Perez, J. D. Phys. Rev. C 7: No. 2, 537-543 (Feb 1973).

Subject to the validity of the K matrix approximation for atomic nuclei, it is shown that the best single-particle wave functions are obtained from a self-consistent potential with rearrangement terms. These terms are derived from variational calculus and it is demonstrated that the solution of the Euler-Lagrange equations provides the single determinant wave function with maximal overlap with the true wave function. We solve the equation for the rearrangement term due to the removal of one particle and show that all K matrix elements are on the energy shell. (auth)

14151 METHOD OF CORRELATED QUASIPARTICLES. II. 0^+ PARTICLE-PARTICLE RESIDUAL INTERACTIONS. Chasman, R. R. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 7: No. 2, 553-560 (Feb 1973).

The method of correlated quasiparticles is extended to treat the problem of attractive particle-particle matrix elements in the generalized 0^+ mode. A computationally convenient approach to the problem is presented. Sample calculations are performed and compared with the results of pairing model calculations. It is concluded that the nonpairing 0^+ matrix elements play an important role in determining the ground-state properties of deformed nuclei. (auth)

14152 PAULI EXCLUSION EFFECTS IN REACTIONS INVOLVING MULTINUCLEON SYSTEMS. Gambhir, B. L. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Griffin, James J. Phys. Rev. C 7: No. 2, 590-610 (Feb 1973).

To investigate the importance of effects of Pauli exclusion principle in reactions involving multinucleon systems, we consider reactions in which deuterons are incident on a recoilless nucleus. First, the binding energy of a model deuteron in the presence of a nuclear Fermi gas (an infinite nucleus) is calculated as a function of nuclear density and deuteron kinetic energy so as to provide some clues to the range of incident energies and nuclear densities where exclusion effects can be expected to be important. The results show that this model deuteron is unbound in the presence of infinite nuclear matter, unless it has a kinetic energy, at least, of the order of 100 MeV. Making some simplifying assumptions, then, we pose a model problem and obtain for the deuteron breakup, elastic scattering, and stripping reactions, Hilbert-Schmidt integral equations in which the Pauli term, in each case, can be identified. Corresponding to Pauli break-up term, Pauli break-up cross sections for deuterons on ^{16}O nucleus have been calculated in a simple model. The dependence of cross sections on directions along which the break-up products emerge and the energy partition among them is investigated. The variation of cross section with incident deuterons' kinetic energy and with nuclear density is also studied. The most prominent and important feature of Pauli breakup is the sharp peaking of cross sections for very asymmetric partition of energy among outgoing particles and is very encouraging for an experimental test. Finally, by considering Pauli breakup of an artificially tightly bound deuteron, we conclude that the Pauli mechanism should be of importance in α-particle reactions as well. (auth)

14153 SINGLE-PARTICLE DENSITY OF THE RENORMALIZED FERMI-GAS MODEL. Ghosh, Sudip Kumar (Saha Institute of Nuclear Physics, Calcutta 9, India); Chatterjee, Aparesh. Phys. Rev. C 7: No. 2, 840-853 (Feb 1973).

It is well known that the nuclear single-particle level density g_{obs}, obtained from statistical nuclear reactions, does not follow the behavior of a free Fermi gas; previous attempts to reproduce g_{obs} have largely been empirical. We have used the properties of our renormalized gas model (RGM) to deduce an approximate analytic expression for our model density of g_{RGM}. We study the consequence of the concept of momentum anisotropy in the phase space of the RGM system relative to the isotropic distribution of the free Fermi gas. We find that our model is a very suitable one to fit in with this concept. With fair accuracy, we find that $g_{RGM}=g_{obs}$ throughout the range of stable nuclei, $50 \leq A \leq 250$. The effects of specific model interaction energies (the single-particle combinatorial effects, the pairing, deformation, and Coulomb effects) are all observed in appropriate regions in desired strengths. All these effects are strongly dominated by the prescribed shell structure and its state-mixing and occupation dependence. (auth)

14154 STRIPPING TO AN UNBOUND STATE WITH MULTIPLE DECAY CHANNELS. Vincent, C. M. (Deparment of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213); Fortune, H. T. Phys. Rev. C 7: No. 2, 865-866 (Feb 1973).

An expression is derived for the cross section of the process A+d→B+p→C+c+p in which C and c are not observed. The result is proportional to Γ_n (the partial width of B for n emission) and does not depend on the fact that B may decay into channels other than A+n. (auth)

14155 ALTERNATIVE INTERPRETATION OF APPARENT M2-E1 MIXING IN (γ,γ') REACTIONS. Arad, B. (Department of Nuclear Physics, Soreq Nuclear Research Center, Yavne, Israel). Phys. Rev. C 7: No. 2, 749-750 (Feb 1973).

It is pointed out that the chances for the involvement of two close levels in the nuclear-resonance-scattering process are, for certain cases, as high as 20%. It is shown that when the angular distribution of a two-level scattering process is interpreted in terms of a single level only, the result can show an apparent M2/E1 mixing. An experiment is suggested which will uniquely clear up this question. (auth)

14156 LOW-ENERGY NEUTRON ENERGY SPECTRA AND THE "INVERSE REACTION" CROSS SECTION. Rao, G. R.; Cohen, B. L.; Degnan, J. H.; Chan, K. C. (University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. C 7: No. 2, 733-738 (Feb 1973).

A method is described for determining the 0–1.5-MeV part of the energy spectra of neutrons from (p,n) reactions. It utilizes measurements of energy spectra of neutrons from (p,np) reactions and corrections obtained by various measurements including neutron-proton coincidence studies. When the shapes of the neutron spectra are analyzed with the statistical theory, it is found that the cross section for the "inverse reaction" (capture of a low-energy neutron by a highly excited nucleus) exhibits a giant-resonance behavior as a function of mass number, peaking sharply near A=91. This peak is at least as sharp as is predicted by usual optical-model calculations. (auth)

14157 CONCEPT OF TRANSITION-OPERATOR BOSON AND ITS APPLICATION TO AN EXACTLY SOLUBLE MODEL. Dreizler, R. M. (Institut für Theoretische Physik, Universitat Frankfurt/Main, West Germany); Klein, Abraham. Phys. Rev. C 7: No. 2, 512-521 (Feb 1973).

In phenomenological descriptions of nuclear vibrations a close connection is implied or expressed between the most-collective transition operator and the harmonic-oscillator (boson) variables which are introduced to describe the collective motion. With the help of a widely used example-the monopole vibration model of Meshkov, Lipkin, and Glick-it is shown how this relationship suggests, for the microscopic case, a new and flexible class of boson representations. As shown, these are capable of yielding accurate descriptions of the system not only in the extremes of weak and strong coupling, but in the usually more inaccessible intermediate regions as well. (auth)

14158 REMOVAL AND SINGLE-PARTICLE ENERGIES IN NUCLEI. Faessler, A.; Muether, H. (Kernforschungsanlage, Juelich, Ger.). Z. Naturforsch., a; 28: No. 3-4, 362-368(1973).

The difference between the absolute value of the Hartree–Fock (HF) single-particle energy and the removal energy is studied. This total rearrangement is composed out of the orbital (or spatial) and the Brueckner rearrangement. It is shown analytically within the Pauli–Brueckner HF approach that the saturation potential for a density-dependent effective force is equal to the Brueckner rearrangement energy of the level involved plus a smaller term. This is in ^{16}O accidentally numerically roughly equal to the orbital rearrangement energy. The numerical calculation in ^{16}O of the rearrangement energies for the proton level yields the maximum value (9 MeV) for the $0s\ \frac{1}{2}$ state. The Brueckner rearrangement is a factor two to twenty larger than the orbital rearrangement. (2 figures) (auth)

14159 COUPLING SCHEME RELEVANT TO HIGH ANGULAR MOMENTA AND INTERMEDIATE NUCLEAR DEFORMATIONS. Stephens, F. S.; Diamond, R. M.; Nilsson, S. G. (Univ. of California, Berkeley). Phys. Lett.; 44B: No. 5, 429-432(28 May 1973).

Based on the particle-plus-rotor model, it is shown that a new coupling scheme should occur in nuclei under certain conditions. In this coupling scheme, j is quantized along the direction of I rather than along the symmetry axis. Simple approximate wave functions for this scheme were developed and compared with the exact solutions of the particle-plus-rotor model. (auth)

14160 SHAPE AND STABILITY CALCULATIONS IN HEAVY AND SUPERHEAVY NUCLEI. Hilton, R. R. (Hacettepe Univ., Ankara). Phys. Lett.; 44B: No. 5, 421-424(28 May 1973).

Attention is focused onto the spurious state contributions inherent in existing equilibrium shape and fission half-life assessments of heavy and superheavy nuclei. The results indicate that compensation for such effects is essential if these calculations are to be considered reliable. (auth)

14161 OPTICAL-MODEL AND COUPLED-CHANNEL CALCULATIONS IN NUCLEAR PHYSICS. Raynal, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 281-322 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Optical-model and coupled-channel calculations basically amount to solving a second-order differential equation without first derivatives or a system of such equations, although the most general direct reaction mechanism leads to a set of coupled integro-differential equations. The main numerical methods used for this problem are presented. They are the Numerov method, the modified Numerov method better adapted to coupled equations than the preceding one, the Störmer and the De Vogelaere methods. Simple expressions for the errors are derived; these methods are discussed from the point of view of stability in the asymptotic region when the step size is increased; practical examples of the effects of the step are given. However, all these coupled-channel calculations are time-consuming. The sequential iteration for coupled equations (ECIS) leads to a drastic reduction in computational time in many cases. This method can be used for sets of integro-differential equations but has been only applied to sets of second-order differential equations including first derivatives. The first iteration is related to the DWBA, but gives results in problems beyond the scope of DWBA. The ECIS method can be used in an integral form (Green function) or a differential form as in the code ECIS70. The automatic search methods are also presented. The optical-model code MAGALI, for spin 0, ½, and 1 particles, is described, and also the attempts to introduce automatic search into a coupled-channel code: ECIS71. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

14162 PARTICLE-FIELD INTERACTIONS: NUMERICAL TECHNIQUES AND PROBLEMS. Hockney, R. W. (Univ. of Reading, Eng.). pp 109-127 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Errors inherent in the use of a particle model in the simulation of a physical system are discussed. These arise from N, the particle number, H, the interval of the space mesh, and DT, the time-step. Measurements are presented that show that the collision rate of both the NGP and CIC models is the same and depends mainly on N. Stochastic heating, which leads to poor energy conservation, depends on N in the same way as the collision rate but also strongly depends on H, DT and the model used. The CIC has substantially less heating than the NGP model. Recommendations are made for the choice of H and DT. (auth)

Confinement and Heating

14163 (CONF-730705-3) ORMAK AND NEUTRAL INJECTION. Barnett, C. F.; Berry, L. A.; Bush, C. E.; Callen, J. D.; Clarke, J. F.; Colchin, R. J.; Dory, R. A.; England, A. C.; Hogan, J. T.; Kelley, G. G.; McNally, J. R. Jr.; Murakami, M.; Neidigh, R. V.; Roberts, M.; Rome, J. A.; Wing, W. R. (Oak Ridge National Lab., Tenn.). 1973. 4p. Dep. NTIS $3.00.

The plasma conditions attained in ohmically heated ORMAK experiment provide a satisfactory base for neutral-injection heating. Plasma flows and radial electric fields of the same magnitude as those expected to result from neutral injection have been observed in ORMAK. They appear to have no deleterious effect on the plasma. (auth)

14164 (COO-3165-4) PLASMA HEATING WITH A RELATIVISTIC ELECTRON BEAM. Korn, P.; Sandel, F.; Wharton, C. (Cornell Univ., Ithaca, N. Y.). 1972. Contract AT(11-1)-3165. 5p. (CONF-730705-8). Dep. NTIS $3.00.

Significant plasma heating due to the interaction of an intense relativistic electron beam with a plasma column was observed in a new experiment. The threshold for the onset of heating and the dependence of total perpendicular energy on beam current are similar to the cases for direct turbulent heating in the same plasma geometry. (auth)

14165 (EUR-CEA-FC-682) HEATING OF A PLASMA BY THE INJECTION OF FAST HELIUM ATOMS. Girard, J. P.; Khelladi, M.; Marty, D. A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 25p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

The injection of fast neutral particles appears to be a useful way of heating the plasma confined in a tokamak. The advantages of injecting helium atoms instead of hydrogen atoms were demonstrated: preferential heating of the plasma ions; suppression of losses from fast ions by charge exchange; possible increase in the critical injected current; and absence of runaway helium ions. In addition, the high neutralization efficiency of helium ions up to high energies favors their use in reactors. The main disadvantages reside in the difficulties associated with pumping the helium and avoiding the pollution of the tokamak vacuum enclosure. (FR)

14166 (EUR-CEA-FC-687) EFFECT OF COULOMBIAN COLLISIONS ON THE CONFINEMENT OF PLASMAS BY MIRROR MAGNETIC CONFIGURATIONS. Werkoff, F. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 113p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

Coulomb collisions are the principal cause of rapid losses of charged particles from mirror magnetic configurations. Charged-particle collisions are described by the Fokker-Planck coupled equations, equations which can only be solved numerically in the case of simplified theoretical models. The different models used up until the present day to describe hot ion ($T_i \geq T_e$) plasmas are reviewed together with the results obtained with these models. One of these models was used to numerically simulate the time behavior of a hot-electron plasma ($T_e \gg T_i$). A new theoretical model was developed that takes into account the anisotropies of the slowing-down and diffusion coefficients of the Fokker-Planck equation. The model enabled calculations to be made of the density and confinement time for the particles of hot ion plasmas. In addition, calculations were made on the effect of anisotropies of the diffusion and slowing-down coefficients on the power amplification factor Q in a thermonuclear reactor. (auth)

14167 (FRNC-TH-371) STUDY OF A NONLINEAR DIFFUSION PROBLEM RELATED TO PLASMA PHYSICS. Saussais, J. P. (Paris Univ., Orsay (France)). 1972. 69p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis.

A macroscopic study is presented on the spatiotemporal evolution of a plasma confined in a toroidal magnetic enclosure (TOKAMAK). The magnetohydrodynamic system of equations was used as a starting point. It is assumed that the temporal variation in the density is negligible and that the fluid is at rest. Only the evolution of the temperature and electric current is investigated; it is also assumed that the toroidal effect is negligible, thus permitting the torus to be considered as an infinite cylinder. The stationary equations associated with the single fluid model (nonlinear eigenvalue problems) are studied. The single fluid model equations are made discrete and the stability studied using an implicit finite difference scheme. The same investigations are re-considered for a two-fluid system. The numerical results obtained for the different problems studied are presented in graphical form. (FR)

14168 MICROWAVE HEATING OF ELECTRONS OF A DENSE PLASMA COLUMN AT FREQUENCIES HIGHER THAN ELECTRON CYCLOTRON FREQUENCY. Datlov, J. (Inst. of Plasma Physics, Prague); Kryska, L.; Budnikov, V. N. Czech. J. Phys.; 23: No. 4, 436-442 (1973).

The absorption of plasma waves, excited in a dense plasma column, was investigated and the localization of the regions of efficient heating of electrons was determined in a broad range of parameters: $1 > \omega_{ce}/\omega > 0.1$, $0.3 < n/n_{UH} < 25$, $10^{-5} < v/\omega < 10^{-3}$. The heating of electrons near the second electron cyclotron harmonic was investigated in greater detail. (auth)

14169 TOROIDAL CONFINEMENT "WENDELSTEIN". IPP Presseinformation, No. 49. (1972). vp. (In German).

From information meeting of the Max-Planck Institute for Plasmaphysics; Garching, Germany (7 Nov 1972).

A short account of the stellarator principle is given. The successful experiments with the Wendelstein stellarators are now extended to higher temperatures and light gases (like H, D, He). The plasma heating is carried out by all three methods (ohmic and hf heating, neutral-particle injection). Diagnostics, electronics, vacuum vessels, and energy supply are also discussed. (GE)

14170 CONTROL-THEORETIC APPROACH TO THE PLASMA CONFINEMENT PROBLEM. Wang, P. K. C.; Janos, W. A. J. Optimization Theory Appl.; 5: No. 4, 313-329 (Apr 1970).

The problem of confining a collisionless plasma by means of external electromagnetic fields is formulated as an optimal control or variational problem. The paper begins with a formal development of the equations governing the plasma motion. Then, various mathematical formulations of the confinement problem are discussed. Specific results are obtained for the simplified case where confinement is achieved by means of a spatially uniform time-varying magnetic field. Physical interpretations of these results are also given. (App. Mech. Rev.).

14171 APPLICATION OF COMPUTERS TO PROBLEMS OF CONTROLLED THERMONUCLEAR REACTORS. Rosenbluth, M. N. (Inst. for Advanced Study, Princeton, NJ). pp 157-169 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

The successful applications of computing, and its failures, to the study of the problem of stably confining a plasma in a so-called magnetic bottle is discussed. (auth)

Diagnostics

Refer also to abstract 13484.

14172 (CEA-R-4430) SCATTERING OF LASER LIGHT BY THE PLASMA "FOCUS" OF A COAXIAL GUN. Garconnet, J. P. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Jun 1973. 81p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

An experimental device is presented that allows one to determine the parameters of a pulsed plasma from the forward scattering of a ruby-laser beam. The results predicted by Salpeter's theory are used to evaluate the ion temperature of the plasma "Focus" during neutron emission. Under specified conditions, the broadening of the scattered light depends on the ion temperature through the ion velocity (Doppler shift). The experimental profile of the scattered line is recorded by a 12-channel spectrometer. It is then compared to theoretical profiles. An ion temperature is derived from this comparison. (auth)

14173 (EUR-CEA-FC-636) DEVELOPMENT OF A THOMSON SCATTERING EXPERIMENT UTILIZING THE RAYLEIGH SCATTERING PHENOMENON. Hesse, M.; Tittel, H. O. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 32p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

Equipment was developed for Thomson-scattering experiments on a plasma. The Rayleigh scattering of a gas phenomenon was utilized. Problems concerned with alignment, diaphragms, the attenuation of a laser beam, and black bodies were studied in view of reducing the effect of spurious light. A new calibration method for the recording channels of the Thomson scattering spectra is proposed in view of eliminating the most common errors encountered in absolute calibrations. (FR)

14174 (EUR-CEA-FC-675) MILLIMETER WAVE POLARIMETERS AND THE COTTON–MOUTON EFFECT IN PLASMAS. Mendonca, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec 1972. 129p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Paris Univ., Orsay, France.

Two new types of millimeter- and submillimeter-wave polarizer (constructed in the form of oversized circular guides) are presented. The conception of these polarizers was inspired by infrared techniques (metallic grids and dielectric plates used at Breuster incidence). The transmission and reflection of a wave by these two types of obstacle were studied, an analogy being made with classical transmission line theory. The performance of these polarizers was studied. Problems encountered in measuring the polarization of millimeter waves (in particular slightly elliptical waves) are examined. The efficiency of the polarizers was demonstrated from Cotton–Mouton (Voigt effect) measurements made in a dense plasma in the presence of an intense magnetic field. Calculations of the polarization of a wave propagated through the plasma in an undefined direction with respect to the magnetic field are presented. The geometrical optics approximation in a cold plasma was used; the Cotton–Mouton effect appears as a special case in the calculation. Experimental studies of this effect in a microwave frequency argon plasma discharge are described. A possible application using an interferometer without a reference arm based on the Cotton–Mouton effect is suggested. A brief description is given of an application of this polarimeter to measurements of the profile of the polar magnetic field of Tokamak-type discharges. (FR)

14175 (UCRL–13576) STUDY OF THE TECHNIQUE OF UTILIZING A MICROWAVE FABRY–PEROT RESONATOR TO OBTAIN SPATIAL ELECTRON DENSITY DISTRIBUTIONS IN A MINIMUM-B PLASMA. Struve, K. W. (Brigham Young Univ., Provo, Utah (USA). Dept. of Physics and Astronomy). 15 May 1973. Contract W-7405-eng-48. 105p. Dep. NTIS $7.25.

Thesis. For Lawrence Livermore Lab.

Near electron cyclotron resonance, the spatial electron distribution in the direction of the confining magnetic field of some minimum-B, low-β, plasmas can be measured with a confocal microwave Fabry–Perot resonator aligned along the direction of the confining field. The dielectric constant for the two circular polarizations varies as $(1 \pm \omega_b/\omega)^{-1}$, which factors can be determined by utilizing the knowledge of the axial variation of the confining magnetic field. The plasma is treated as a number of uniform slabs perpendicular to the resonator axis for which average density values can be determined by frequency shift measurements. The number of intervals is limited by the maximum number of frequency shifts observable. A broadband tunable, microwave vacuum window suitable for use with circularly polarized waves was designed, tested and built for the 18- to 26.5-GHz range. It was found to have a VSWR of 1.1 in the center of the range, and less than 2.2 at the extremes for a fixed setting at midrange. Coupling microwave power to and from the resonator is also investigated. (auth)

14176 NEUTRON DIAGNOSTICS OF A FUSIONING PLASMA. Southworth, F. H.; Campbell, H. D. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 16: 12-13(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14177 CURRENT SHEET STRUCTURE IN A THETA PINCH. Kenny, G. R. Nashville; Vanderbilt Univ. (1972). 128p. University Microfilms Order No. 73-14,517.

Thesis (Ph. D.).

The current sheet structure and plasma state inside a theta-pinch device was studied using electric and magnetic field probes. One objective of the experiment was to demonstrate that the probe data is sufficient to allow determination of nearly all important plasma parameters obtainable by the more laborious and exacting spectroscopic, scattering, and interferometer diagnostic techniques. Contamination of the plasma by material ablated from the probes was avoided by operating the device at low energy (1000 J). Spectroscopic measurements showed the helium plasma to be quite free of impurities and substantiated the few eV electron temperature calculated from the probe data. The effects of plasma-probe interactions were noticeable in the data but, in general, the uncertainties of the results were no greater than those associated with other diagnostic methods. In addition to the usual radial electric field measurements, the theta electric field was measured and the data used, in conjunction with current-density values (obtained using a differential magnetic field probe), to calculate the plasma conductivity. The electron temperature was calculated from the conductivity values, and the electron density calculated via $n_e = J_0 B_r / e E_r$. The theta electric field measurement also allowed the net radial plasma velocity to be calculated through the region of the current sheet. The results show that a major part of the current sheet precedes the electron and ion density maxima, and indicate that any shock that may have formed must have been entrained towards the middle of the current sheet. The luminous annulus, which has sometimes been associated with the shock, was found not to represent real gas motion. Preferential diffusion of hot electrons from the Joule heated, peak current region appears to account for the current sheet spreading noted during operation without reverse trapped magnetic field. (Diss. Abstr. Int., B)

14178 INVESTIGATION OF THE ENERGY-EXCHANGE MECHANISMS IN AN rf HELIUM PLASMA. Swallom, D. W. Iowa City, IA: Univ. of Iowa (1972). 102p. University Microfilms Order No. 73-13,595.

Thesis (Ph. D.).

The energy exchange mechanisms present in a pure helium and a helium–neon plasma were investigated using spectroscopic diagnostic techniques. The plasma was spatially resolved, and only the volume element at the plasma centerline was considered in the energy-exchange analysis. The experiment was conducted for a fixed oscillator frequency of 4.0 MHz, a fixed plate input power of 2.0 kilowatts, and a constant total pressure of 0.7 torr. The appropriate emission lines were used to determine the population densities of the n^3S, n^3P, and n^3D levels. Spatially resolved self-absorption measurements were used to determine the 2^3S metastable-level number density. The electron number density of 3.3×10^{13} cm^{-3} was determined from the spatially resolved H_β line wing profiles, and the electron temperature of 8800°K was determined from the spatially resolved lower bound levels of the excited helium. The addition of 10% neon gas caused a measurable decrease in the population densities of the lower bound levels of helium. The resonance transfer rate from the 2^3S level of helium to the 2s level of neon was calculated (3.0×10^{16} cm^{-3} sec^{-1}). The electron number density and temperature differences from the pure helium case remained within experimental error when 10% and 20% by volume of neon was added to the helium. Three models (local thermal equilibrium, corona, and collisional-radiative) were examined, and the collisional-radiative model was found to best describe the energy exchange mechanisms for the 2^3S level. This model was also appropriate for describing the helium–neon plasma at this level. The same model was also applied to the 2^3P level to describe the energy exchange mechanisms at that level. (Diss. Abstr. Int., B)

Kinetics (General)

Refer also to abstract 13483.

14179 (COO-2168-5) ANNUAL PROGRESS REPORT, SEPTEMBER 1, 1972–MAY 31, 1973. McCune, J. E.; Sigmar, D. J. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Plasma Physics). 1973. Contract AT(11-1)-2168. 8p. Dep. NTIS $3.00.

Summaries of work during this period are given for the following: (1) theory of drift universal and drift cone modes of collisionless plasma in cylindrical geometry, (2) effects of plasma inertia on toroidal confinement, and (3) neoclassical transport theory of multispecies plasmas. (MOW)

14180 LASER ABSORPTION MEASUREMENTS IN A SUPERSONIC ARGON PLASMA. Smith, D. R. State College, MS; Mississippi State Univ. (1973). 166p. University Microfilms Order No. 73-13,621.

Thesis (Ph. D.).

The purpose of the investigation was to determine if excitation of the electronic states involved in three dominant argon–ion laser transitions could be achieved in a supersonic flow in which the excitation region was a finite distance upstream of the supersonic expansion. An arc-heated argon plasma tunnel was designed and constructed. For excitation of the argon gas, a magnetoplasmadynamic arc was used. To achieve supersonic flow, a two-dimensional uncooled slit orifice nozzle was used. The existence of the argon ion electronic states was investigated by probing transversely across the supersonic flow with a diagnostic laser beam. The relative magnitude of the densities of the argon ionic states was indicated by the absorption of the low-power probe beam by the plasma stream. Sustained excitation of the $4s^2P_{\frac{1}{2}}$ (4765 Å lower laser level) and $4s^2P_{\frac{3}{2}}$ (5145 and 4880 Å lower laser levels) was detected in the dense plasma jet exiting the slit orifice. The oxistence of $4s^2P_{\frac{1}{2}}$ and $4s^2P_{\frac{3}{2}}$ argon electronic states was indicated by the absorption of a diagnostic laser beam with wavelengths of 4765 Å and 5145 Å, respectively. The data obtained with the 5145-Å beam were confirmed with measurements obtained with a 4880-Å beam. Sustained generation of excited argon ions was correlated with a particular MPD arc operating mode which had well defined characteristics. The magnitude of the MPD arc current required for excitation of the electronic states depended on the electronic state. Maximum absorption of the diagnostic beams occurred when maximum MPD arc current was initially obtained for the particular experiment conducted at a specified pressure. Absorption coefficients up to 0.0004 and 0.0013 cm^{-1} were detected 1 cm downstream of the slit orifice with a 4765- and a 5145-Å beam, respectively. (MOW)

14181 RF CONDUCTIVITY OF PLASMA IN THE PRESENCE OF MAGNETIC FIELD BY FREQUENCY-SHIFT MEASUREMENTS. Ram, V.; Chandra, A.; Sarkar, D. C. (Aligarh Muslim Univ., India). Indian J. Pure Appl. Phys.; No. 12, 850-852(Dec 1972).

An attempt was made to apply the frequency shift measurement method for the study of the variation of the rf conductivity of a plasma with pressure in the range 1 to 300 μ Hg. It is assumed that the plasma tube is a leaky capacitor, and the frequency of the rf oscillator exciting the plasma is measured with and without plasma in the discharge tube in the presence of perpendicular nonresonant high-intensity (100 to 1500 G) and parallel low-intensity (0 to 180 G) magnetic fields. It was observed that the conductivity increases appreciably with magnetic field in the case of a parallel magnetic field, while in the case of a high-intensity perpendicular magnetic field, the rf conductivity increases only slightly. (auth)

14182 ION-BEAM INTERACTION WITH THETA-PINCH TURBULENT PLASMA OF LOW PRESSURE. Mitropan, I. M. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 4, 573-577 (Apr 1973). (In Russian).

When an ion beam of 9 to 15 keV passes through a nonisothermal theta-pinch plasma in the low-pressure region ($p = 6 \times 10^{-3}$ to 10^{-1} mm Hg), asymmetric broadening of the ion-beam energy spectrum is shown to occur. This broadening takes place under resonance conditions between the plasma frequency of electrons, ω_{pe}, and higher harmonics ($n = 2, 4, 8$) of the electron cyclotron frequency ω_{He}. The ion beam energy spectrum broadens in plasma asymmetrically in dependence on the resonance magnetic field direction by ~+1 keV or ~–1 keV. The energy spectrum asymmetry can be explained by the presence of the fluctuation electric fields along the magnetic field in the theta-pinch turbulent plasma. (auth)

14183 STRUCTURED DISCHARGES IN HIGH-FREQUENCY PLASMAS. Penfold, A. S. (Telic Corp., Santa Monica, CA); Thornton, J. A.; Warder, R. C. Jr. Czech. J. Phys.; 23: No. 4, 431-435(1973).

Experiments are described in which structured discharges, including stationary and moving striations, were observed in 4-MHz rf plasmas generated using two solenoidal coil configurations. The structured plasmas that formed in the vicinity of the solenoidal coils were not quenched when elaborate precautions were taken to shield the capacitive electric fields. Measurements of the rf power input to the plasma and the resistance reflected by the plasma into the drive circuit showed no discontinuous change during the formation or disappearance of the structured discharges surrounding the solenoidal coils. Observations of striated rf discharges reported by other investigators are reviewed. Arguments are given to support the conclusion that the striation-like structures observed in rf plasmas and the moving striations observed in dc plasmas are part of the same general family. (auth)

Kinetics (Experimental)

14184 (EUR-CEA-FC-660) BEHAVIOR OF THE PLASMA IN THE HARMONICA-TWO MACHINE. Ginot, P.; Plinate, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 62p. (In French). Dep. NTIS (U. S. Sales Only) $5.25.

The most recent experimental results obtained with the Harmonica-Two machine (a variable curvature torus) are given together with an overall survey of all the experimental work carried out. Large helical perturbations of the plasma column are observed. These perturbations agree with theoretical predictions concerning their modes and phases when the rotational transform is about 2, the value for which the magnetic lines of force spiral in resonance with the curvature of the torus. The experimental conditions are too crude to enable observations to be made of more delicate phenomena such as macroscopic stability zones. The plasma is in fact in constant interaction with the walls. (FR)

Kinetics (Theoretical)

14185 (EUR-CEA-FC-690) STOCHASTIC THEORY FOR HIGH TURBULENCE IN PLASMAS USING THE VLASOV APPROXIMATION. Misguich, J. H. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 23p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

The Vlasov equation for a plasma in a stochastic external field enables a closed evolution equation to be deduced for the mean distribution function in which the fluctuating component of the self-consistent field due to the action of the stochastic field on the distribution function is explicitly taken into account. This equation generalizes the Weinstock equation for the case of a stochastic external field. Three different expressions are given for this equation: in terms of the Weinstock propagator, the Vlasov propagator, and the Benford and Thomsom propagator. This last expression enables a simple definition to be given for the stochastic quasi-linear approximation. This approximation takes into account the effect of the mean self-consistent field on the free particle trajectories and thus represents the analogue of the Dupree equation in the stochastic case. (auth)

14186 HYDRODYNAMICS OF A PLASMA IN AN INTENSE HIGH-FREQUENCY FIELD. Gorbunov, L. M. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk; 109: No. 4, 631-665(Apr 1973). (In Russian).

The basic equations for the hydrodynamics of a plasma in a high-frequency field are outlined, and the forces acting on a plasma situated in a high-frequency field (the frequency of which being much greater than the Langmuir frequency of electrons) are examined. Special aspects of the subject are discussed: dispersion equations which describe small excitations in a homogeneous and infinite plasma, decaying instability, and parametric resonance and short-wave excitations for $\omega_0 \approx \omega_{Le}$. Attention is focused on equilibrium plasmas in high-frequency and standing-wave fields, the penetration and reflection of a strong electromagnetic wave, and nonlinear stationary waves. Spreading out, acceleration, and compression of a layer of plasma are analyzed. (227 references) (KSW)

14187 CONTRIBUTION OF COMPUTER SIMULATION TO PLASMA THEORY. Dawson, J. M. (Princeton Univ., NJ). Comput. Phys. Commun., Suppl.; 3: 79-85(Sep 1972).

Recent advances in computers and in techniques for simulating plasmas have made it possible to investigate rather complicated nonlinear and turbulent phenomena in plasmas. Quite a number of problems have been investigated in recent years. Among them, anomalous absorption of intense electromagnetic waves due to the turbulence associated with parametric instabilities excited by the electromagnetic wave, the diffusion of plasma across strong magnetic fields due to thermally excited convective motion, limiting amplitudes of ion waves, and the coupling of intense plasma oscillations due to ion density fluctuations. From the simulation one can generally gain a pretty good idea of the mechanisms involved and construct theories for the observed effects. The present status of simulation and a few examples of how it has been used to aid theory are given. (auth)

Production

Refer also to abstract 14193.

14188 (CEA-R-4410) THEORETICAL STUDY OF LASER-CREATED PLASMAS CONFINED BY AN EXTERNAL MAGNETIC FIELD. Martineau, J. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Jun 1973. 84p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis. Submitted to Paris Univ., Orsay (France).

The heating of a deuterium laser-created plasma from solid pellets (~100 μ in diameter; ~10^{17} particles) confined by strong magnetic fields B_0 (up to 1 MG) was studied. Ionization phase is taken into account. The inverse-bremsstrahlung absorption mechanism and induced Compton effect are the main heating processes. Using an inhomogeneous hydrodynamic model to describe the plasma dynamics, the skin depth due to the diffusion of the magnetic field inside the plasma is calculated. For finite conductivity $T \propto B_0^{\frac{1}{2}}$ instead of $T \propto B_0^{\frac{1}{3}}$ for infinite conductivity. The magnetic body force for a diffusing plasma is given by $\vec{J} \times \vec{B}$ while for the infinite conductivity model on the other and the force is derived from the magnetic pressure $B_0^2/2\mu_0$ on the plasma boundary. The efficiencies for CO_2 lasers and neodymium glass lasers are compared. It is important to feed the energy slowly to obtain a high efficiency of incident laser energy to the plasma thermal energy. (auth)

14189 (SLA-73-5363) HIGH-CURRENT-DENSITY ELECTRON-BEAM APPLICATION TO FUSION STUDIES. Yonas, G.; Poukey, J. W.; Freeman, J. R.; Prestwich, K. R.; Toepfer, A. J.; Clauser, M. J.; Beckner, E. H. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 5p. (CONF-730705-10). Dep. NTIS $3.00.

Mechanisms for electron beam focusing and absorption in solid targets are considered in relation to applications to ablation driven, spherical super compression of D-T. With recent developments in beam concentration, the requirement for effective shortening of the electron deposition length remains as the principal unanswered question. (auth)

14190 (UCID-16222) REVIEW OF PELLET CONCEPT; MOTIVATION FOR PLASMA PHYSICS STUDIES. Bodner, S. E. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Mar 1973. Contract W-7405-Eng-48. 12p. (CONF-730335-1). Dep. NTIS $3.00.

A brief review of the laser-pellet fusion concept is given. Absorption mechanisms, electron mean free path problems, and plasma theory and simulation results are then briefly reviewed. (MOW)

14191 NUCLEAR APPLICATIONS OF LASERS. Cooper, R. S. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 5(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14192 PRODUCTION AND DETECTION OF ^{20}Na FOR THE USE AS RADIOACTIVE TRACER IN GAS DISCHARGES. Baghuis, L. C. J.; Hagedoorn, H. L. (Technische Hogeschool, Eindhoven, Netherlands). Physica; 65: No. 1, 163-171(1 Apr 1973).

A method for the production and detection of ^{20}Na for the use as a tracer in gas-discharge experiments is described. The production takes place via a (p,n) reaction in a neon-gas target. A discharge moves the ^{20}Na ions towards the cathode behind which a beta counter is mounted. In this way a discrimination can be made between radiation emitted by isotopes inside the discharge volume and radiation emitted by isotopes outside the discharge volume and in the surrounding walls. By this method the cross section for the ^{20}Ne(p,n)^{20}Na reaction is determined for proton energies between 17 and 20 MeV: σ(17 MeV) = 7 ± 3 mbarn, σ(18 MeV) = 24 ± 6 mbarn, σ(19 MeV) = 30 ± 6 mbarn, σ(20 MeV) = 34 ± 6 mbarn. The measured half-life of 450 ± 30 ms is in good agreement with values reported in the literature. (auth)

Stability

14193 (COO-3237-18) LASER FUSION AND PARAMETRIC INSTABILITIES. Rosenbluth, M. N.; Sagdeev, R. Z. (Institute for Advanced Study, Princeton, N. J.). 1973. Contract AT(11-1)-3237. 15p. Dep. NTIS $3.00.

Some plasma physics problems that determine the effective coupling between the laser and plasma are examined. These include parametric instabilities and backscatter instabilities. A possible saturation mechanism for the backscatter into plasmons is discussed. (MOW)

14194 (FRNC-TH-373) STABILIZATION OF DRIFT WAVES BY A MAGNETIC FIELD IN WHICH THE LINES OF FORCE ARE SHEARED. Khiet, T. (Paris Univ., Orsay France)). 1971. 107p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

It is shown that drift waves can be stabilized by sufficiently shearing the lines of force. The case of low-β plasmas (laboratory plasmas) is considered, and the plate plasma model is used. In the case of a uniform magnetic field, it is possible to analyze the instability of the drift modes using the dispersion relation established in the framework of local theory. The equation reduced to a simple algebraic equation in the two separate regions: resonant modes and fluid modes (parallel phase velocity greater than the velocity of the thermal electrons). In the shearing case, an analysis is developed that enables the variation in the magnetic field to be included. Normal-mode analysis is completed by that of the wave packets for the case of a large 1/a ratio. In the nonlinear plane the turbulent spectrum is studied, together with the anomalous diffusion coefficient. The experience seems to confirm the linear variation of the diffusion coefficient as a function of the shearing as is exposed in the formula. (FR)

14195 (ORO-3405-37) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Annual Progress Report No. 8. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). 1 Jun 1973. Contract AT(40-1)-3405. 15p. Dep. NTIS $3.00.

Summaries of work during this period are given for the following: (1) parametric excitation of ion-acoustic waves, (2) standing waves in a moving plasma medium, (3) anomalous plasma resistivity, turbulence in collisionless plasma, and nonresonant, rf, plasma heating, (4) asynchronous quenching effects in beam-plasma interactions, and (5) Lashinsky-Cap equation for convection phenomena. (MOW)

14196 STUDY OF BEAM-PLASMA INSTABILITIES IN HIGH-PERVEANCE, SELF-FOCUSED ELECTRON BEAMS. Gibson, R. A. Raleigh, NC; North Carolina State Univ. (1972). 105p. University Microfilms Order No. 73-13,915.

Thesis (Ph. D.).

The development of electron guns and modes of operation in which high-perveance, high-density beams are produced without the necessity of stabilizing magnetic fields has made possible investigations of beam-plasma instabilities in modes previously not observed for such beams. In particular, the hose instability, beam-plasma oscillations near the background electron plasma frequency and much below it, oscillations near the background ion plasma frequency, and standing waves of electron oscillations are observed and distinguished. Additional oscillations are observed and distinguished. Additionally, with the recent development of a comprehensive theory for electrostatically self-focused beams (McCorkle and Bennett, 1972), it has been found possible to correlate the appearance of oscillations in the system to particle densities and temperatures in a much more complete manner than has previously been done. (Diss. Abstr. Int., B)

14197 LOW-FREQUENCY MACROSCOPIC INSTABILITIES OF A FULLY IONIZED MAGNETOPLASMA. Rognlien, T. D. Stanford, CA; Stanford Univ. (1973). 200p. University Microfilms Order No. 73-14,968.

Thesis (Ph. D.).

The plasma is assumed to be immersed in a uniform magnetic field, and is either uniform or has a number density gradient perpendicular to the magnetic field. A moment equation description of the ion and electron dynamics is used; collisions are assumed to have a strong effect on electron motion along the magnetic field. Before considering specific modes, a stability analysis is developed that allows a classification of wave-growth characteristics to be made for a bounded system from solutions to the dispersion relation for an infinite system. Also, a method is given for calculating the normal mode frequencies and wave profiles by using the reflection coefficients at the boundaries. For wave propagation perpendicular to the magnetic field, the flute wave is studied in cylindrical geometry. The destabilizing effect of a radial electric field is considered by solving a differential equation. Both analytic and numerical solutions are given that include the eigenfrequencies and eigenfunctions. The effect of the plasma column being radially bounded is investigated, and results of previous workers are generalized. The transition to Kelvin-Helmholtz instability is illustrated for sharp rotational shear of the column. In addition, two instabilities observed in a hollow-cathode arc discharge experiment carried out at Stanford are identified as flute instabilities. For propagation at an angle to the magnetic field, resistive drift waves driven unstable by a density gradient are considered in rectangular geometry. A general dispersion relation is derived that includes ion axial motion, electron heat transfer, and electron axial drift. Comparison is made with dispersion relations of other authors, and the effects of these terms on the wave solutions are illustrated; both frequency and values of the first-order variables are given. The solutions are interpreted for

bounded systems, using the method presented in the thesis. This provides a proper explanation of some experimental results obtained elsewhere from a drift wave experiment in a Q-machine. The characteristics of an entropy or temperature wave are also studied. For propagation parallel to the magnetic field, the stability of ion-acoustic waves is studied; frequency and values of the first-order variables are again given. The destabilizing effect of electron drift is investigated, and it is shown that an estimate of the threshold drift for instability given by other investigators is too large if $T_i < T_e$, due to collisional energy exchange between electrons and ions. Further, instability is found in the absence of an electron drift when $2T_i \lesssim T_e$, again due to collisional energy exchange. Normal mode solutions for a bounded plasma are also given. These results are valid for a plasma in which the temperature difference is maintained by an external source. In addition, the case of a plasma equilibrating in time ($T_i \rightarrow T_e$) is considered, and it is found that here ion-acoustic instability should not grow to a significant amplitude. (Diss. Abstr. Int., B)

14198 ION CYCLOTRON INSTABILITY OF ROTATING PLASMA. Kirochkin, Yu. A.; Sizonenko, V. L.; Stepanov, K. N. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 4, 621-629(Apr 1973). (In Russian).

Instability is considered of the rotating plasmic cylinder placed in crossed radial electric and longitudinal magnetic fields. It is shown that if the relative velocities of electrons and ions are considerably less than the thermal velocity of the ions, the potential short-wave oscillations with frequencies multiple to the frequency $\Omega_{ij} = \omega_{Bi} - 2\omega_j$, where ω_{Bi} is the cyclotron frequency and ω_j the frequency of ion rotation, are excited in the plasma. (auth)

14199 THREE-DIMENSIONAL PICTURE OF DEVELOPMENT OF INSTABILITY DURING INTERACTION OF A MODULATED ELECTRON BEAM WITH A PLASMA. Lavrovskii, V. A.; Rogashkova, A. I.; Kharchenko, I. F.; Tseitlin, M. B. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 8, 1405-1407(Aug 1972).

Translated from Radiotekh. Elektron.; 17: No. 8, 1766-1768 (Aug 1972).

The problem is formulated with boundary conditions and is solved within the framework of a nonlinear theory, which creates the prerequisites for the most complete and systematic comparison of the results with experiment. The development of the instability of a velocity-modulated electron beam at the boundary of a semi-infinite plasma cylinder is theoretically described. (MOW)

14200 STABILITY OF NON-EQUILIBRIA OF THE RESISTIVE SHEET PINCH. Barston, E. M. Commun. Pure Appl. Math.; 25: No. 1, 63-76(Jan 1972).

The stability of a class of time-dependent states of a resistive viscous incompressible magnetohydrodynamic sheet pinch is investigated. The class of states considered corresponds to situations with vanishing mass flow of the plasma in which a magnetic field diffuses. It is shown that if the product of resistivity and viscosity is sufficiently large, these states are stable. The instability appearing for weak dissipative effects is explicitly discussed for the case of constant resistivity. (Appl. Mech. Rev.)

Thermonuclear Engineering and Equipment

Refer also to abstracts 13317, 13318, and 15024.

14201 (CONF-730902-1) FORESEEABLE THERMAL, MECHANICAL, AND MATERIALS ENGINEERING PROBLEMS OF FUSION REACTOR POWER PLANTS. Fraas, A. P. (Oak Ridge National Lab., Tenn.). 1972. Contract W-7405-eng-26. 30p. Dep. NTIS $3.50.

From 2nd international conference on structural mechanics in reactor technology; West Berlin, F. R. Germany (10 Sep 1973).

The engineering problems that will be posed by full-scale fusion reactor power plants are illustrated by examining a representative conceptual design. The temperature extremes that must be accommodated run from 4°K in superconducting magnets to 10^{8}°K in the plasma. These temperature differences lead to difficult problems with differential thermal expansion, high heat fluxes, and stringent thermal insulation requirements. The magnetic fields that must be provided run from 25 to 100 kG, and these fields induce forces on elements of the structure of the order of 20,000 tons. The walls of the chamber containing the plasma must withstand intense radiation by 14-MeV neutrons and 1- to 50-keV ions. Unusual fluid-flow and heat-transfer problems include two-phase boiling flow of helium in the cryogenic magnets, magnetohydrodynamic effects on the flows of red-hot lithium and boiling potassium in a high magnetic field. These and many other problems must be solved in such a way as to give a reliable, safe system at a reasonable capital cost, and this must be done with materials whose resistance to corrosion and nuclear, physical, and fabrication properties meet all of the requisite boundary conditions. (auth)

14202 (NP-19785) ENERGY THROUGH NUCLEAR FUSION INSTEAD OF THROUGH NUCLEAR FISSION. New System Allows Rapid Participation of the Anticipated Highly Economic Nuclear Fusion. Nowak, K. [nd]. 4p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Directed against each other, two ion beams are mixed with electrons and then collide in a vacuum chamber. Plasma densities of 10^{23} to 10^{24} ions/cm^3 are possible because no radial expansion pressure exists. Calculations show that, within a reaction length of one meter, 100% fusion can be obtained. The proposal has been patented in Britain, France, and Germany. The construction of a prototype fusion power plant will cost about 5 million DM, and the plant is expected to be in operation within two years after start of construction. (HBG)

14203 (ORNL-TM-4200) CROSS-SECTION SENSITIVITY OF TRITIUM BREEDING IN A FUSION REACTOR BLANKET: EFFECTS OF UNCERTAINTIES IN CROSS SECTIONS OF ^{6}Li, ^{7}Li, AND ^{93}Nb. Tobias, M.; Steiner, D. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 36p. Dep. NTIS $4.00.

The cross-section sensitivity is studied for the tritium-breeding ratio in a fusion reactor blanket model, which is representative of a large class of blanket configurations under current investigation. The calculated sensitivity of the breeding ratio to estimates of the uncertainties in cross sections of ^{6}Li, ^{7}Li, and ^{93}Nb is summarized. (MOW)

14204 (UCRL-74675) SIMULATION OF 14-MeV NEUTRON DAMAGE TO POTENTIAL CTR MATERIALS. Borg, R. J. (California Univ., Livermore. Lawrence Livermore Lab.). 29 May 1973. 18p. (CONF-730416-3). Dep. NTIS $3.00.

From second Cairo solid state conference; Cairo, United Arab Republic (21 Apr 1973).

A review is given of the major CTR designs being considered with special reference to the problem of neutron damage. Subsequently, a review is given of the aims and methods of the simulation program in progress at the Lawrence Livermore Laboratory. This program centers about the Rotating Target Apparatus, which is currently the world's most powerful source of 14-MeV neutrons capable of continuous production of approximately 10^{12} n/cm^2/sec. This machine is described in detail as are the preliminary results of an attempt to correlate and compare 14-MeV damage to V, Nb, Mo, and Cu with proton and reactor neutron damage. (auth)

14205 CROSS-SECTION SENSITIVITY OF BREEDING RATIO IN A FUSION-REACTOR BLANKET. Bartine, D. E.; Alsmiller, R. G. Jr.; Oblow, E.; Mynatt, F. R. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 8-9(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14206 STATUS REPORT FROM KMS FUSION. Gomberg, H. (KMS Fusion, Inc., Ann Arbor, MI). Trans. Amer. Nucl. Soc.; 16: 9(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14207 OPTIMIZATION CONSIDERATIONS IN THE DESIGN OF A TOKAMAK REACTOR. Klein, D. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 10-11(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14208 14-MeV NEUTRON FLUX CAPABILITIES OF A SMALL MIRROR FUSION DEVICE. Petrie, T. W. (Southern Illinois Univ., Carbondale); Miley, G. H.; Chilton, A. B. Trans. Amer. Nucl. Soc.; 16: 11-12(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14209 CONTROLLED FUSION RESEARCH AND EDUCATION IN U. S. UNIVERSITIES. Trivelpiece, A. W. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 14(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14210 COMMENTS ABOUT FUSION TECHNOLOGY STUDIES AT THE UNIVERSITY OF ILLINOIS. Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 16: 14-15(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14211 EDUCATIONAL AND RESEARCH ACTIVITIES IN FUSION TECHNOLOGY AT THE UNIVERSITY OF MICHIGAN. Kammash, T. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 16: 15-16(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14212 FUSION REACTOR ENGINEERING IN THE NUCLEAR ENGINEERING CURRICULUM AT THE UNIVERSITY OF TEXAS AT AUSTIN. Draper, E. L. Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 16: 16(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14213 EDUCATION AND RESEARCH IN CONTROLLED FUSION AT THE UNIVERSITY OF WISCONSIN. Emmert, G. A.; Forsen, H. K.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 16-17(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14214 PERTURBATION THEORY FOR NEUTRON AND PHOTON TRANSPORT CALCULATIONS IN CONTROLLED FUSION BLANKETS AND SHIELDS. Conn, R. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 16: 343-344(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14215 MICRO FISSION-FUSION CHAIN REACTIONS. Winterberg, F. (Univ. of Nevada, Las Vegas). Lett. Nuovo Cim.; 7: No. 9, 325-330(30 Jun 1973).
A mixture of fissionable and fusionable material under high pressure and density is considered. A relation for the temperature and neutron flux is derived. Critical mass calculations are presented. (MOW)

14216 PULSATOR: A TOKAMAK EXPERIMENT. IPP Presseinformation, No. 51. (1972). vp. (In German).
From information meeting of the Max-Planck Institute for Plasmaphysics; Garching, Germany (7 Nov 1972).
Technical parameters and the main problems to be solved in connection with the pulsator (e.g., stability under programmed perpendicular fields, pre-ionization, corrugation of toroidal field, and wall separation by magnetic separatrix) are briefly described. (GE)

Wave Phenomena

14217 IMPULSIVE REFLECTION FROM A MOVING HOMOGENEOUS PLASMA. Rattan, I.; Gautama, G. D. (Indian Inst. of Tech., New Delhi). J. Phys., D (London); 6: No. 8, L85-L86 (21 May 1973).
From the known steady-state solution for a moving isotropic homogeneous plasma half-space, the reflected field of an impulsive plane electromagnetic wave incident normally on a vacuum/moving-plasma interface is derived. It is concluded that the reflected field $E_r(\tau)$ is an explicit function of the velocity and frequency of the moving plasma. (auth)

14218 NONLINEAR WAVE INTERACTIONS ON A PLASMA COLUMN. Larsen, Jean-Marc Stanford, CA; Stanford Univ. (1973). 164p. University Microfilms Order No. 73-14,923.
Thesis (Ph. D.).
A theoretical and experimental study was made of two particular cases of nonlinear wave interaction in a plasma column. The frequencies of the waves are of the order of magnitude of the electron plasma frequency. Ion motions are neglected. The nonlinear coupling of slow waves on a plasma column is studied by means of cold plasma theory. The quasi-static approximation is used to simplify the analysis. Waves in a metal tube filled with plasma, and on a uniform plasma column surrounded by an infinite dielectric, are considered in the limit of an infinite magnetic field parallel to the axis of the column. The case of a plasma column surrounded by an infinite dielectric in the absence of a magnetic field is also examined. The linear properties of slow waves are reviewed, and solutions are obtained for use in the nonlinear theory. Nonlinear scattering from a plasma column in an electromagnetic field having its magnetic field parallel to the axis of the column is studied. Some observations of nonlinear scattering are presented, and the effect of the Earth's magnetic field and of discharge symmetry on the radiation pattern are discussed. The influence of collisional loss on the nonlinear scattering amplitude is also considered. (MOW)

14219 NONLINEAR EXCITATION OF AN ION-ACOUSTIC WAVE IN A BOUNDED PLASMA. Shaptala, V. G. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 4, 654-658(Apr 1973). (In Russian).
Linear and nonlinear transformations of an electromagnetic wave in a plasma are discussed; in the nonlinear case a current arises that is perpendicular to the boundary of the plasma. If the frequency of the second harmonic is equal to the frequency of the characteristic ion-acoustic oscillations of the plasma, then the nonlinear transformation of the incident s-polarized wave occurs in the ion-acoustic mode. This effect allows one to observe the nonlinear transformation of a wave in a pure form and may possess a significance in the study of a wave-plasma interaction. (KSW)

14220 THEORY OF TM-WAVE SELF-FOCUSING IN AN ANISOTROPIC PLASMA. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Authority, Cairo). Physica; 65: No. 2, 396-411 (15 Apr 1973).
The self-focusing of an electromagnetic electric-type wave beam propagating in an inhomogeneous plasma across a strong magnetic field is analyzed. The field structure and conditions indispensable for the formation of a self-sustained waveguide channel are determined. It is demonstrated that the process of electromagnetic wave propagation (the self-focusing in particular) in plasma is unstable with respect to the specific parametric-type instabilities. The possibility of high-frequency electromagnetic-field penetration into the "nontransparent" region of a magnetoactive plasma is noted as well. (auth)

14221 EXCITATION OF ELECTROMAGNETIC WAVES IN A PLASMA WITH A RELATIVISTIC ELECTRON BEAM. Bogdankevich, L. S.; Dolzhenko, O. V.; Rukhadev, A. A. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 8, 1298-1303 (Aug 1972).
Translated from Radiotekh. Elektron.; 17: No. 8, 1766-1768 (Aug 1972).
The frequency spectra, the line width, and the decrements of the oscillations excited by the beam are investigated under conditions of Cherenkov and cyclotron instability. From the analysis of the general dispersion equation of arbitrary (nonpotential) electromagnetic waves one finds the conditions for quasipotentiality of the oscillations in the most interesting case of Cherenkov instability, possessing maximal increment of rise. The obtained results are discussed from the viewpoint of the possibility of using strong-current relativistic beams for generation of uhf radiation. (auth)

14222 NONLINEAR WAVES IN A WAVEGUIDE PARTIALLY FILLED WITH A PLASMA. Petrzilka, V. A. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 23: 615-620(1973).
Nonlinear waves were studied in a circular waveguide partially filled with a cold magnetized collisionless plasma. The solution obtained is periodic with the frequency increasing as a square root of the amplitude of the solution in the first approximation. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 12837, 13122, 13317, 13978, 13984, 14205, 14214, 14247, and 14250.

14223 (AD-746462) SAM-CE: A THREE-DIMENSIONAL MONTE CARLO CODE FOR THE SOLUTION OF THE FORWARD NEUTRON AND FORWARD AND ADJOINT GAMMA-RAY TRANSPORT EQUATIONS. Final Report. Cohen, M. O.; Guber, W.; Lichtenstein, H.; Steinberg, H. A.; Troubetzkoy, E. S. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Nov 1971. Contract DASA01-70-C-0083. 283p. (MR-7021; DNA-2830-F). NTIS.

The SAM-CE system is a FORTRAN Monte Carlo computer code designed to solve the time-dependent neutron and gamma ray transport equations in complex three-dimensional geometries. SAM-CE is applicable for forward neutron calculations and for forward as well as adjoint primary gamma ray calculations. Time-dependent fluxes, and flux functionals such as dose, heating, count rates, etc., are calculated as function of energy, time and position. A special feature of SAM-CE is its use of the combinatorial geometry technique which affords the user geometric capabilities exceeding those available with other commonly used geometric packages. All nuclear interaction cross section data (derived from the ENDF/B-2 library for neutrons and from the UNC-format library for gamma rays) are tabulated in point energy meshes. (auth) (GRA)

14224 (AD-749980) MODIFICATION OF THE SAM-CE SYSTEM TO SAM-CE REVISION A. Lichtenstein, H.; Troubetzkoy, E. S.; Beer, M. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Aug 1972. Contract DASA01-70-C-0083. 29p. (MR-7030; DNA-2958-F). NTIS

The most recent coding developments, which constitute Revision A of the SAM-CE Transport Code System, are summarized. Several exercises, which have been performed to demonstrate the production status of the SAM-CE system, are discussed. A machine independent post-processor, BCDE-AN, which effects machine independence for a SAM-X generated EDT, and consequently the SAM-CE system, is described. The physics, mathematics, and coding details, including operating instructions, for the SAM-CE system are extensively described in the SAM-CE code manual, which complements the report. (auth)

14225 (AD-751617) SAM-CE: A THREE DIMENSIONAL MONTE CARLO CODE FOR THE SOLUTION OF THE FORWARD NEUTRON AND FORWARD AND ADJOINT GAMMA-RAY TRANSPORT EQUATIONS. Revision A. Final Report. Cohen, M. O.; Guber, W.; Lichtenstein, H.; Steinberg, H. A.; Troubetzkoy, E. S. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Jul 1972. Contract DASA01-70-C-0083. 182p. (MR-7021 (Rev. A); DNA-2830-F(Rev. A)). NTIS.

The SAM-CE system is a FORTRAN Monte Carlo computer code designed to solve the time-dependent neutron and gamma ray transport equations in complex three-dimensional geometries. SAM-CE is applicable for forward neutron calculations and for forward as well as adjoint primary gamma ray calculations. In addition, SAM-CE is applicable for the gamma ray stage of the coupled neutron-secondary gamma ray problem, which also may be solved in either the forward or the adjoint mode. (auth)

14226 (AD-753191) DESIGN OF A MONTE CARLO RADIATION TRANSPORT CODE FOR THE ILLIAC IV. Final Report. Steinberg, H. A.; Troubetzkoy, E. S.; Kalos, M. H. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Sep 1972. Contract DNA001-72-C-0057. 61p. (MR-7031; DNA-2972-F). NTIS.

The SAM-CE Monte Carlo radiation penetration code has been completely redesigned for efficient operation on the ILLIAC IV computer. Parallelization has been achieved by queuing up calculations of similar nature. (auth)

14227 (ANL-7970, pp 12-13) RANDOM NUMBER SET FOR MONTE CARLO DOSE COMPUTATIONS. Frigerio, N. A. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

14228 (ORNL-TM-4273) APSAI: A COMPUTER CODE FOR PLOTTING FLUXES AND ABSORPTION DENSITIES GENERATED BY THE ANISN CODE. Sahin, S. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $3.75.

APSAI enables the user to plot fluxes obtained from one or more previous ANISN calculations. It is possible to plot on the same graph output from up to 9 different ANISN runs having the same energy groups, mesh spacing and geometrical size. Further, the user can plot several geometry- or energy-dependent fluxes on the same figure, often an advantage. Subroutine ACTIV allows plotting the absorption densities dependent on the x-coordinate. In addition, the damage flux and up to 5 activities at the outer boundary can be calculated. APSAI makes activity calculations and plots neutron or gamma-ray spectra from ANISN calculations using INTRIGUE-II-C. (MHR)

14229 (SLA-73-5250) THEORETICAL ANALYSIS OF THE ENERGY SPECTRA OF BACKSCATTERED IONS. Brice, D. K. (Sandia Labs., Albuquerque, N. Mex.). 1973. 27p. (CONF-730632-1). Dep. NTIS $3.50.

From international conference on ion beam surface layer analysis; Yorktown Heights, New York, USA (18 Jun 1973).

An equation is derived which governs the energy spectrum of ions backscattered from a target whose composition varies continuously with depth. The equation also includes the effects of path-length straggling on the energy spectrum through integrations over the depth distributions of both the incident and backscattered ions. When path-length straggling is negligible, the equation reduces to a simple form, not involving integrations. The general equation is used along with model ion depth distribution functions to investigate the effects of the shape of the ion distribution on the predicted backscattered spectrum. Delta functions, gaussian, and several skewed distributions are used for this investigation. The predicted backscattering spectra from these different distributions show little difference except at the energies corresponding to the back edge of a thick film target. At these energies the gaussian provides some spreading of the observed edge, and skewing produces additional broadening and some tailing. For realistic skewing of the ion distributions the predicted tailing is not sufficient to account for the low energy tails observed in many experiments. These results suggest that accurate spatial ion distributions will be required before detailed analysis can be carried out on the sharp features of thick target spectra. The simplified form of the general equation is used along with an iterative procedure to obtain the depth distribution of target composition from a complex experimental spectrum. (auth)

14230 PHOTON WAVELENGTH SELECTION FOR MONTE CARLO ON PARALLEL COMPUTERS. Cavanaugh, G. P.; Chilton, A. B. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 16: 139-140(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14231 COHERENT-INCOHERENT PHOTON SCATTERING IN DISCRETE ORDINATES TRANSPORT CALCULATIONS. Renken, J. H.; Adams, K. G.; Biggs, F. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 16: 351-352(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14232 REVIEW OF X-RAY CROSS SECTIONS. Hubbell, J. H. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 353-355(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14233 ANALYTIC X-RAY TRANSPORT THEORY. Cole, R. K. Jr. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 16: 358(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14234 RADIATION ANNEALING OF FRENKEL PAIRS AND THE RATE OF THE POINT DEFECT ACCUMULATION IN NEUTRON IRRADIATION. Altovskii, I. V. (State Committee on Uses of Atomic Energy, Moscow). Radiat. Eff.; 17: No. 3-4, 275-280 (1973).

In neutron irradiation the primary knocked-out atom, when producing secondary defects and slowing down, releases its energy in the cascade zone which, being heated up to a temperature higher than the ambient, provides the migration of the Frenkel pairs and their annihilation (radiation annealing). The system of equations which is presented describes the diffusion and annihilation of the defects and the cooling of the cascade zone resulting from the lattice and electron heat transfer. The solution of the system, using simplifying assumptions, brings one to the conclusion that the effectiveness of the Frenkel pair production, by the primary knocked-out atoms with an energy lower than a certain boundary energy, decreases because the atom dissipates its energy in a region of smaller dimensions, which is heated to higher temperature and,

thus, the more incisive radiation annealing of the Frenkel pairs is provided. In accordance with this the number of secondary knocked-out atoms at energies lower than the boundary energy is small and is described with the power dependence where the power is about three. Formulas are derived for the number of secondary knocked-out atoms in metals and dielectrics with allowance for the temperature of the material under irradiation. Taking into account radiation annealing, agreement can be reached between the experimental and theoretical values for the initial rate of the defect accumulation in neutron irradiation of the materials. (auth)

14235 DEFECT CLUSTER PRODUCTION IN THE RADIATION ANNEALING OF THE FRENKEL PAIRS. Altovskii, I. V.; Platonov, P. A. (State Committee on Uses of Atomic Energy, Moscow). Radiat. Eff.; 17: No. 3-4, 269-273(1973).

In reactor neutron irradiation the primary knocked-out atom, forming secondary defects and thus slowing down, loses energy in the zone of developing cascade which, when heated to a temperature higher than ambient temperature, provides the migration and annihilation of the Frenkel pairs and their coagulation which results from heavy-defect supersaturation. An equation expressed in partial derivatives with respect to time and cluster multiplicity was derived describing the kinetics of cluster formation in the cascades produced by the primary knocked-out atoms having arbitrary energy. The solution of the equation gives the dependence of the cluster concentration and multiplicity in the cascade zone on the initial energy of the slowing down atom. Formulas describing the amount of clusters produced by the primary knocked-out atom in the initial ideal material were derived for the case of loop dislocation (extraplanes) and for the case of spherical vacancy clusters. (auth)

14236 PLURAL AND MULTIPLE MOTT SCATTERING BY MONTE CARLO METHOD. Hnizdo, V. (Univ. of Edinburgh). Nucl. Instrum. Methods; 109: No. 3, 503-507(1973).

Finite scatterer thickness corrections to Mott scattering of electrons from gold are calculated by a Monte Carlo method. The case of normal beam incidence and detection angle of 120° is considered, and results are presented for eight kinetic energies in the range 46 to 290 keV. (auth)

14237 APPROXIMATE STOPPING POWER LAW OF ELECTRONS AND POSITRONS. Batra, R. K.; Sehgal, M. L. (Aligarh Muslim Univ., India). Nucl. Instrum. Methods; 109: No. 3, 565-569(1973).

A convenient empirical formula for the total stopping power of electrons and positrons of initial kinetic energy from 0.3 MeV to 5.0 MeV in any substance was found; it gives values within an accuracy of 4%. This formula indicates that the sum of the energy loss contributions due to ionization, excitation, and bremsstrahlung processes varies nearly linearly with the atomic number of the absorber. The usefulness of the new formula for solid state detectors is also pointed out. (3 figures, 3 tables) (auth)

14238 FACTORS FOR CONVERTING BETA-RAY DOSE RATES MEASURED IN AIR TO DOSE RATES IN TISSUE. Owen, B. (National Physical Lab., Teddington, Eng.). Phys. Med. Biol.; 18: No. 3, 355-368(May 1973).

Factors for deriving β-ray dose rates at a depth in tissue from dose rate measurements in air have been determined experimentally for $^{90}Sr + ^{90}Y$, ^{204}Tl and ^{147}Pm using tissue-equivalent plastics. The factors considered were backscattered radiation from tissue, absorption in the overlying tissue layer and the mass stopping power ratio of tissue to air. (auth)

14239 INVARIANT IMBEDDING AND RADIATION DOSIMETRY. IV. Finite Order Scattering of Gamma Radiation by a Target Slab. Belman, R. (Univ. of Southern California, Los Angeles); Ueno, S.; Vasudevan, R. Mathematical Biosciences; 17: 89-104(1973).

Computation of the transmission and reflection functions of the radiation impinging on a slab with scattering properties which are unisotropic and incoherent are relevant to the problems in radiation dosimetry, where the passage of low energy gamma radiation through human tissue is found. Employing the concept of finite order transmission and reflection functions of earlier papers in this series, recurrence relations are obtained for these functions which introduce enormous simplicity in the numerical calculations. (auth)

14240 SI UNITS IN RADIOLOGY AND RADIATION MEASUREMENT. Liden, K. (International Commission on Radiation Units and Measurements, Washington, DC). Phys. Med. Biol.; 18: No. 3, 462-470(May 1973).

A table is presented of radiological SI units and their equivalents expressed in rads, roentgens and curies. It is pointed out that the SI units imply substantial changes in the numerical values of the actual quantities, when expressing activity, absorbed dose, absorbed dose rate, exposure and exposure rate. The difficulties are discussed with particular reference to medical safety and an invitation is made by the ICRU to offer comments and suggestions. (UK)

14241 COMPUTED IONIZATION AND KERMA VALUES IN NEUTRON IRRADIATED GASES. Dennis, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Med. Biol.; 18: No. 3, 379-395(May 1973).

As an aid to accurate neutron dosimetry the mean W values, $\overline{W}$, have been calculated for a tissue-equivalent gas mixture, ethylene, acetylene and carbon dioxide at twenty-one different neutron energies in the range 0.1–15.5 MeV. The calculations are based on a previously derived relationship for the mean value of the energy, W(E), expended in forming an ion pair by a heavy ion of mass M, atomic number Z and initial energy E. For energies below 1.0 MeV per a.m.u. this relation takes the form $W(E) = W_\beta[1.035 + A(Z)(E/M)^{-n(Z)}]$ and at higher energies $W(E) = W_\beta E/(E\text{-constant})$ where W_β is the mean value required to form an ion pair by an electron. Details of the cross-sections and kinetics of all the possible neutron induced reactions in the elements hydrogen, carbon, nitrogen and oxygen are given. Kerma and the energy expended as elastic nuclear scattering are also evaluated at each neutron energy from the differential secondary particle spectra. (auth)

14242 "PLURAL-SERIES" APPROXIMATIONS OF FUNCTIONS. Spencer, L. V. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 76B: No. 3-4, 91-108(1972). (1972).

A method is given for developing approximations to neutron and gamma-ray transport distributions in the form of a superposition of U_n^k polynomial series multiplied by exponentials and characterized by different scale factors. Convergence conditions and error bound expressions are given. Biorthogonality properties are worked out. Examples are given in which these approximations are compared with polynomial approximations. (auth)

14243 NEUTRON EXPOSURE IN INVESTIGATION OF RADIATION DAMAGE TO MATERIALS IN NUCLEAR REACTORS. Kramer Ageev, E. A.; Ogorodnik, S. S.; Popov, V. D.; Tsoglin, Yu. L. At. Energ. (USSR); 34: No. 4, 255-258(Apr 1973). (In Russian).

In most cases, radiation damage to materials is investigated in nuclear reactors. To compare the results of irradiation in different reactors a common exposure scale is necessary. This paper describes methods of measuring neutron exposure in radiation damage experiments and two exposure units are proposed. One of these is the dose of neutrons in hydrogen. Calculations using various radiation damage models (Rossin, Kinchin and Pease, etc.) for 19 elements ranging from Be to Bi show that the deviation of the ratio of the total number of atoms (n_α) to the dose in hydrogen (J^H) does not exceed 13% for 14 reactor spectra. To decrease the error to 3% it is necessary in addition to determine the ratio of the number of ^{238}U fissions or surplus activity to the dose in hydrogen. In the latter case, $n_\alpha/J^H = c_1 + c_2 J^{U^{238}}/J^H$, where the values of c_0 and c_1 are given. (2 figures, 2 tables, 11 references)

Radiation Protection Standards

14244 NUCLEAR LEGISLATION. Analytical Study. Regulations Governing Nuclear Installations and Radiation Protection. Paris; Organization for Economic Co-Operation and Development (1972). 492p.

This volume is part of the analytical study of the major aspects of nuclear energy legislation in force in OECD member countries. For all countries that were members of OECD on 1st June 1971, the fundamental radiation protection legislation, the system of authorization and control of nuclear installations, the system of authorization and control of radioactive material, the protection of the public and the protection of workers are reviewed. (auth)

Radiation Source Calibration and Standardization

Refer also to abstract 12986.

Shielding Calculations and Experiments

Refer also to abstracts 13318 and 14424.

14245 (AD-748662) ANALYSIS OF NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN CONCRETE USING THE

SAM-CE MONTE CARLO CODE. Cohen, M. O. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). Nov 1971. Contract DASA01-70-C-0083. 106p. (MR-7022; DNA-2809-F). NTIS.

SAM-CE is a Monte Carlo computer code designed to solve the neutron and gamma ray transport equations in complex three-dimensional geometries. In the study, the SAM-CE code was used to analyze the time-dependent transport of neutrons and secondary gamma rays in slabs of concrete. Calculationally determined counting rates and energy leakage spectra, at a detector located behind the concrete slabs, are compared with similar experimental results obtained by Gulf Radiation Technology. (auth)

14246 (ORNL-TM-4196) DEVELOPMENT AND APPLICATION OF A DISCRETE ORDINATES ADJOINT DIFFERENCE METHOD FOR ONE DIMENSIONAL SHIELD WEIGHT OPTIMIZATION. Childs, R. L.; Engle, W. W. Jr.; Robinson, J. C.; Mynatt, F. R. (Oak Ridge National Lab., Tenn.). Jun 1973.

Thesis. Submitted by R. L. Childs to Univ. of Tennessee, Knoxville.

An improved method for the weight optimization of one-dimensional layered shields was developed. The radiation transport problem is represented by coupled neutron-gamma ray discrete ordinates transport calculations. In the optimization procedure, forward and adjoint calculations are performed for the initial shield design. An approximate form of the perturbed adjoint is used in the adjoint difference approach to determine the effect of shield changes, and a simple closed form optimization algorithm is used as in the ASOP code. Three realistic shield optimization problems were solved to demonstrate the capabilities of the method. A comparison between the results obtained using this method and the ASOP code showed the agreement of the two methods to be very good and the new method to be significantly faster. (auth)

14247 SHIELDING OF MANNED SPACE VEHICLES AGAINST GALACTIC COSMIC-RAY ALPHA PARTICLES. Santoro, R. T.; Alsmiller, R. G. Jr.; Chandler, K. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 335-336(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14248 PERTURBATION METHOD FOR SHIELD WEIGHT OPTIMIZATION. Childs, R. L. (Oak Ridge National Lab., TN); Robinson, J. C.; Engle, W. W.; Mynatt, F. R. Trans. Amer. Nucl. Soc.; 16: 346-347(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14249 POINT ISOTROPIC GAMMA-RAY BUILDUP FACTORS IN CONCRETE. Eisenhauer, C. (National Bureau of Standards, Washington, DC); Simmons, G. L. Trans. Amer. Nucl. Soc.; 16: 358-360(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14250 ANALYTICAL TREATMENT OF PHOTON TRANSPORT IN TWO-LAYERED MEDIA. Maniscalco, J. A.; Hungerford, H. E. (Purdue Univ., Lafayette, IN). Trans. Amer. Nucl. Soc.; 16: 360-361(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14251 NEUTRON PENETRATION DATA FOR CONCRETE. Simmons, G. L. (Science Applications, Inc., Huntsville, AL); Eisenhauer, C. Trans. Amer. Nucl. Soc.; 16: 363-364(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14252 PROCEDURE FOR THE PROTECTION OF OBJECTS AGAINST RADIOACTIVE RADIATIONS. Mueller, E.; Straeter, A. (to Blohm Voss AG). German Patent 1,669,086. 6 May 1970. Filed date 29 Aug 1967. (In German).

A procedure is described for the protection of objects against radiation. A homogeneous mixture is prepared of a material that absorbs radiations with a plastic material, and this mixture is deposited on the interior and exterior of the objects at room temperature. (EJH)

14253 CALCULATING TELETHERAPY ROOM SHIELDING USING ALBEDOS. A Method for Predicting Exposure Rates At, and Shielding Required In, Maze-Protected Doors. Toy, A. J.; Hoecher, F. E. (Univ. of Kansas, Lawrence). Phys. Med. Biol.; 18: No. 3, 452-461(May 1973).

It is suggested that the exposure rate at the maze-protected door of a therapy room can be computed using the concept of γ-ray albedo and a digital computer, if the exposure rate in the useful beam at some distance, the amount of leakage radiation and the room dimensions are known. The results of computer calculation showed attenuation factors of 150 to 1000 for typical therapy rooms with maze walls and for γ-ray energies of 200 keV to 1.25 keV. Lower γ-ray energies resulted in lower attenuation factors in this energy range. The attenuation, by lead, of scattered photons could oe predicted by assuming that the scattered photons all have an energy resulting from Compton scattering through graphically estimated angles. (auth)

14254 SEMIANALYTICAL METHOD FOR CALCULATING THE NEUTRON FIELD IN A STRAIGHT ONE-DIMENSIONAL SHIELD. Ignatov, A. A.; Shikhov, S. B.; Suvorov, A. P. Vop. Fiz. Zashch. Reaktorov; No. 5, 57-63(1972). (In Russian).

The exact solution of neutron transport boundary value problems can be obtained on the basis of a complete system of elementary solutions of the kinetic equation (the Case method). The boundary value problem for a shielding layer irradiated by an external source is reduced to a system of linear algebraic equations on the basis of the representation of the continuous portion of the spectrum of the transport operator by discrete points. Calculations by the method of elementary solutions in one- and two-group consideration are compared with calculations by the method of discrete ordinates based on the ROZ program. (JPRS)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 15061, 15140, and 15142.

14255 MINKOWSKI METRIC FOR A MULTIDIMENSIONAL GEOMETRY. Rauscher, E. A. (Univ. of California, Berkeley). Lett. Nuovo Cim.; 7: No. 10, 361-367(7 Jul 1973).

The generalized Minkowski metric is constructed for a multidimensional geometry in terms of physical variables termed quantal units. The Minkowski metric is discussed in detail for the space $\{x_j \rightarrow n = 4\}$ which is covered by the N-8 superspace. New light-cone relations implied by this metric are presented. (LBS)

14256 WAVE OPERATORS AND POSITIVE EIGENVALUES FOR THE SCHROEDINGER EQUATION WITH OSCILLATING POTENTIAL. Matveev, V. B. (Leningrad State Univ.). Teor. Mat. Fiz.; 15: No. 3, 353-366(Jun 1973). (In Russian).

The radial Schroedinger operator H with oscillating potential is considered. The main result consists in obtaining the new integral condition of the existence and completeness of the wave operators $W_{\pm}(H,H_0)$ and the law of possible distribution for positive eigenvalues of H. (auth)

14257 ASYMPTOTICAL EXPANSIONS OF GENERALIZED FUNCTIONS. II. Brychkov, Yu. A. (Computer Center, Moscow). Teor. Mat. Fiz.; 15: No. 3, 375-381(Jun 1973). (In Russian).

Asymptotical expansions are obtained for some classes of generalized functions of the form $f(x)e^{ixt}$, $t \rightarrow \pm\infty$, where $f(x)$ possesses a countable number of singular points, such as poles and branching points. Examples of applications to the evaluating asymptotical behavior of the Fourier integrals are given. (auth)

14258 PHYSICAL INTERPRETATION OF A MANIFESTLY COVARIANT HAMILTONIAN FORMALISM FOR DIRAC PARTICLE. Hanus, W. (Nicholas Copernicus Univ., Torun, Poland). Acta Phys. Pol., B4: No. 3, 403-414(1973).

As a continuation of considerations concerning a covariant Hamiltonian formalism previously proposed, the FW-representation of the homogeneous Dirac equation and the definitions of the "mean" position and spin operators were reformulated in a manifestly covariant way. Problems of a consistent physical interpretation of the displayed mathematical scheme were discussed, and some of its controversional aspects explained. (auth)

14259 BOSE–EINSTEIN CONDENSATION OF THE GAPLESS HARTREE–FOCK MODEL HAMILTONIAN. Lee, K. C. (Seoul National Univ.). New Phys. (S. Korea); 12: No. 4, 161-170(Dec 1972). (In Korean).

The thermodynamic properties of Bose-Einstein condensation of the gapless Hartree–Fock Hamiltonian, a truncated Hamiltonian for an interacting boson system, are investigated. The thermodynamic functions of this model system are exactly calculated. It is shown that the phase transition is precisely of the third order in Ehrenfest's classification. (auth)

14260 REMARKS ON STATISTICAL MECHANICS OF INTERACTING SYSTEMS. Isihara, A.; Takahashi, Y. (Univ. of Alberta, Edmonton). Progr. Theor. Phys. (Kyoto); 49: No. 1, 146-152(Jan 1973).

Relations are discussed among the Montroll-Ward propagator, the Lee-Yang binary kernel and Watson's two-body collision operator. The fundamental errors in previous work on the Montroll-Ward method are pointed out. (auth)

14261 INERTIA CENTER MOTION OF AN AGGREGATE OF POINT-LIKE PARTICLES IN ANALYTICAL MECHANICS. Ionescu-Pallas, N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 1, 123-128(1973).

The explicit expression of the Lagrange function for a system of point-like particles is derived in the framework of analytical mechanics accounting for the velocity dependence of the interparticle interaction and without resorting to the field theories or to the action invariance under the Poincare infinitesimal transformations. (JFP)

14262 QUANTUM FOUNDATIONS OF THE EXPONENTIAL DECAY LAW. Fonda, L.; Ghirardi, G. C.; Rimini, A.; Weber, T. (Univ., Trieste, Italy). Nuovo Cim.; 15A: No. 4, 689-704(21 Jun 1973).

By assuming that in every actual decay process the unstable system is subject to repeated processes of measurement which ascertain whether the system is decayed or not, it is proved that the decay law is exponential, obtaining a consistent reconciliation of the quantum and the classical statistical descriptions of decay experiments. It is also shown that the measurement process is a localization of the decay products and that, consequently, the unstable system is reduced to a unique quantum state. Within the framework of ordinary quantum mechanics, a natural definition of the wave function of the unstable system is given. (auth)

14263 AVERAGED VARIATIONAL PRINCIPLES CONTAINING HIGHER DERIVATIVES. Anderson, D. (Chalmers Univ. of Tech., Goteborg). Lett. Nuovo Cim.; 7: No. 9, 317-320(30 Jun 1973).

The technique of averaged variational principles is extended to include the case of Lagrangians containing higher-order derivatives. (JFP)

14264 APPLICATION OF THE GENERAL STATISTICAL WICK'S THEOREM TO SPIN HAMILTONIANS FOR S = 1. Westwanski, B. (Univ., Katowice, Poland). Phys. Lett.; 44A: No. 1, 27-28(7 May 1973).

The general statistical Wick's theorem for the case of the most general subsystem Hamiltonian acting in a three-dimensional Hilbert space is discussed in detail. (auth)

14265 EQUIVALENCE OF CHARGE AND ENERGY. Whitmire, D. P. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 7: No. 8, 305-309(23 Jun 1973).

The possible equivalence of charge and positive gravitational energy was previously suggested by Leiby (Astrophys. Space Sci., 17: 368(1972)). It is pointed out that for a consistent theory the equivalence must be between charge and all forms of energy (not simply positive gravitational energy) and that this new hypothesis does not conflict with known experimental data. A relatively easy laboratory experiment capable of testing the equivalence of charge and all forms of energy is suggested. (LBS)

14266 DIFFERENCE METHODS IN FLUID DYNAMICS, WITH APPLICATIONS. Killeen, J. (Univ. of California, Livermore). pp 129-156 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

Finite-difference methods for solving the differential equations of fluid dynamics are described. Time-dependent, initial-value problems in one and two spatial dimensions are considered. Also discussed are the applications of these methods to problems in meteorology and magnetohydrodynamics. (auth)

14267 GENERATION OF FEYNMAN DIAGRAMS BY THE USE OF FORTRAN. Perrottet, M. (CNRS, Marseille). pp 555-565 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

A FORTRAN program which generates unrenormalized Feynman diagrams is described. This program is based on a combinatorial analysis only and acts in the following way: given either an interaction or a mixture of interactions, a number of vertices, a number of external lines and their types, it constructs all the corresponding graphs. To achieve this, one introduces a matrix $N(i,j)$, $1 \leq i \leq IS$, $1 \leq j \leq IT$, where i is the index of rows, IS is the number of vertices, j is the index of columns, and IT/2 is the number of lines involved in the interaction. To each kind of field appearing in the interaction a line of definite type is associated, which is characterized by a positive integer. A line of type b connected to the vertex K will be labelled by the pair (K,b). All the lines of the vertex K lie in the K-th row of N, which is simply the juxtaposition of all the pairs $(K\ b_j)$, $j = 2,4,\ldots,$ IT. An internal line is taken to be the connection of two pairs of the same type; the construction of diagrams consists of all possible connections of such pairs. The external lines are defined to be lines which cannot be connected: they are expressed in N by pairs (0 0). The matrix obtained from N by taking into account the external lines is the main input of the program. In the output a diagram is given by a three-column matrix denoted by IRES. A row of IRES is of the form (K b H) and represents an internal line of type b connecting the vertices K to H. Various elimination tests are performed in order to obtain only inequivalent diagrams. (auth)

14268 COMPUTER SOLUTION OF SYMBOLIC PROBLEMS IN THEORETICAL PHYSICS. Hearn, A. C. (Univ. of Utah, Salt Lake City). pp 567-596 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

A survey of the computing techniques currently available for

the solution of nonnumerical problems in theoretical physics and related areas is presented. The subject is considered in three general sections. In the first section, a comparison is made between the more familiar numerical calculation by computer and the analogous algebraic calculation, and the limitations of the latter are discussed in detal. Several systems currently available for performing such algebraic calculations are reviewed. A survey is also made of some of the techniques which are presently under development but not yet generally available. In the second section, a detailed examination of a specific problem in algebraic simplification, namely polynomial manipulation, illustrates some of the programming techniques which are used in this field. Several specific programming examples are presented and some current system implementations are discussed in detail. In the final section, a more general symbolic problem is discussed, namely the computer analysis of physical theories represented in terms of diagrams. It is also discussed to what extent a completely automated computer calculation of an analytic expression for a physical cross-section or related parameter in quantum electro-dynamics is possible from a diagrammatic specification of the problem. (auth)

Quantum Field Theories

Refer also to abstracts 13572, 13574, 13642, 13709, and 14128.

14269 (JINR-P2-6867, pp 141-164) ULTRAVIOLET ASYMPTOTICS WITH COUPLING CONSTANT FINITE RENORMALIZATION. Shirkov, D. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

14270 (JINR-P2-6867, pp 165-182) BOUND SYSTEMS OF TWO PARTICLES IN QUANTUM ELECTRODYNAMICS. Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

14271 (JINR-P2-6867, pp 183-200) ASPECTS OF THE PLANE-POLARIZED APPROXIMATION BY MEANS OF QUANTUM FIELD THEORY. Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In school of high-energy physics for young scientists.

14272 (JINR-P2-7114) SIMPLE PROPERTY OF THE GROUND STATE FUNCTIONAL IN THE MODEL OF QUANTUM BOSON FIELD THEORY WITH SELF-ACTION. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The formula $p(p_1p_2 \dots p_n) = \prod_i \sqrt{\frac{1}{2\pi\Delta(p_i)}} \exp\left[-\frac{\phi(p_i)\phi(-p_i)}{2\Delta(p_i)} + \dots\right]$ was derived for the function $\rho(p_1p_2 \dots p_n)$, obtained by integrating the square of normalized functional of the ground state with respect to all the variables except $\phi(p_1)$, $\phi(-p_1)$, $\dots$ $\phi(p_1)$, $\phi(-p_n)$. (auth)

14273 (JINR-P2-7129) ORTHOGONALITY OF PHYSICAL AND MATHEMATICAL VACUA IN THE SIMPLEST QUANTUM FIELD THEORY MODEL. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Orthogonality of physical and mathematical vacua in the model $g\phi^4$ for small g is proved for the case of one space and one time degree of freedom. (auth)

14274 OPERATOR GAUGE TRANSFORMATIONS IN QUANTUM ELECTRODYNAMICS. Haller, K. (Univ. of Connecticut, Storrs). Nucl. Phys.; B57: No. 2, 589-603(1973).

An operator transformation is formulated which transforms electromagnetic potentials and spinor fields from one gauge to another. Commutation rules are transformed under this gauge transformation and, in particular, change from the commutation rules of the Lorentz gauge to those of the Coulomb gauge when the appropriate gauge transformation is made. The equations of motion are also correspondingly transformed. The transformation is used to generate commutation rules and equations of motion for the null-plane gauge. (auth)

14275 CONSTRUCTION OF INTERACTING QUANTUM SCALAR FIELD IN $\Lambda:(\Phi^4)_4$: THEORY. Raczka, R. (Inst. of Nuclear Research, Warsaw). Lett. Nuovo Cim.; 7: No. 6, 217-220(9 Jun 1973).

A solution $\Phi(x)$ is sought for a nonlinear equation satisfied by $\Phi(x)$ which is a quantum scalar field in the four-dimensional space-time. An alternative manner of defining the product: $\Phi^3(x)$ of the studied equation is proposed. (JFP)

14276 UNCANONICAL HAMILTONIAN MODEL OF A CLASSICAL RELATIVISTIC TWO-BODY SYSTEM. Droz-Vincent, P. (Univ., Paris). Lett. Nuovo Cim.; 7: No. 6, 206-208(9 Jun 1973).

It is suggested that in the case of interaction the Hamilton equations of motion still hold while extra terms are added to the covariant formulation for the trivial case of two free particles $H = \frac{1}{2}p^{\alpha}p_{\alpha}$, $H' = \frac{1}{2}p^{\alpha'}p_{\alpha'}$. (JFP)

14277 CLOTHING OPERATORS IN QUANTUM FIELD THEORY. Fateev, V. A.; Shvarts, A. S. (Moscow Engineering Physics Inst.). Dokl. Akad. Nauk SSSR; 209: No. 1, 66-69(1 Mar 1973). (In Russian).

Four theorems are postulated relative to polarization in a vacuum in quantum field theory, based on an invariant Hamiltonian which satisfied canonical commutational relations. (KSW)

14278 HYPERVIRIAL THEOREMS APPLIED TO THE LINEAR OSCILLATOR WITH VELOCITY-DEPENDENT ANHARMONICITY. Maduemezia, A. (Univ. of Ibadan, Nigeria). J. Phys., A (London); 6: No. 6, 778-782(Jun 1973).

An alternative derivation is given of a perturbation theoretic scheme for the anharmonic oscillator recently proposed by Swenson and Danforth (J. Chem. Phys.; 57: 1734-7 (1972)). The scheme uses the hypervirial and Hellmann-Feynman theorems. The calculation is extended to velocity-dependent perturbations. As a special case, the linear relativistic quantum oscillator is studied to second order, and the corresponding energies worked out. Various powers-of-momentum expectation values are also worked out in this order. (auth)

14279 INTERACTING TACHYON FIELD MODEL. Jue, C.; Hong, H. S. (Kyungpook National Univ., Taegu, Korea). New Phys. (S. Korea); 12: No. 4, 132-137(Dec 1972). (In Korean).

A soluble tachyon field model is formalized from the assumption that tachyons are virtual particles. The coupling of a tachyon to a bradyon is given in the form of the commutation relations. This model does not include any divergence catastrophe, does not make use of Sudarshan's reinterpretation principle, and shows the very symmetry between the "bare" and "physical" states. (auth)

14280 WEYL TRANSFORMATIONS AND POINCARE GAUGE INVARIANCE. Bregman, A. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 667-696(Feb 1973).

Invariance under Weyl transformations of a scale and Poincaré gauge invariant matter Lagrangian is established by introducing a minimally coupled vector gauge field, ϕ_μ, and a Weyl invariant modified spin gauge field, $A_{kl\mu}$. The identities governing the corresponding modified matter Lagrangian are derived in a form that is manifestly covariant under both Weyl and Poincaré gauge transformations. In particular it is shown that the covariant divergence of the energy-momentum tensor is proportional to a set of Lorentz force type terms, i.e., to products of the various gauge field currents and the corresponding gauge invariant field strengths. The case that the field ϕ_μ is related to the derivative of a scalar field is examined; it is found that use of the simplest possible free Lagrangians for the various fields leads to a modification of the Brans-Dicke theory (in its singular version where the Brans-Dicke parameter ω has the value $-(6/2)$) corresponding to the presence of torsion and an asymmetric energy-momentum tensor. (auth)

14281 4-SURFACE OF STATIONARY VOLUME EMBEDDED IN A 5 DIMENSIONAL PSEUDO-EUCLIDEAN SPACE. I. Wan, K. K.; Derrick, G. H. (Univ. of St. Andrews, Fife, Scotland). Acta Phys. Pol.; B4: No. 3, 367-378(1973).

The 4-surface of stationary 4-volume embedded in a 5-dimensional pseudo-Euclidean space is studied as a model field theory. This model field shares many essential features with Einstein's general relativity. In particular it is generally covariant and intrinsically nonlinear, yet it is much simpler and more manageable especially in quantum theory. It is hoped that a study of such a simpler model will help towards a similar study of much more complex theories such as general relativity. (auth)

14282 4-SURFACE OF STATIONARY VOLUME EMBEDDED IN A 5 DIMENSIONAL PSEUDO-EUCLIDEAN SPACE. II. Wan, K. K.; Derrick, G. H. (Univ. of St. Andrews, Fife, Scotland). Acta Phys. Pol.; B4: No. 3, 379-401(1973).

Previously a generally covariant and intrinsically nonlinear model field, the 4-surface of stationary volume embedded in a 5-dimensional pseudo-Euclidean space, was introduced. Two new methods are put forward to study the model. The first one is an everywhere-slowly varying field approach which is essentially perturbative. The second one is a variational method which is able to lead to some finite results. (auth)

14283 NONLOCAL QUANTUM ELECTRODYNAMICS. Tran Hu'u Phat (Univ., Warsaw). Acta Phys. Pol.; B4: No. 3, 311-328(1973).

Nonlocal quantum electrodynamics is constructed satisfactorily. The theory is free of ultraviolet infinities, its S-matrix is macrocausal, unitary on the mass shell and fulfils gauge invariance. (auth)

14284 QUANTUM ELECTRODYNAMICS WITHOUT ULTRAVIOLET INFINITIES. Tran Hu'u Phat (Univ., Warsaw). Acta Phys. Pol.; B4: No. 3, 329-346(1973).

Quantum electrodynamics without ultraviolet infinities is constructed satisfactorily. The cosmic field, discovered earlier is utilized as the regularized field of the theory. The mechanism of violation of the scale invariance principle is outlined for the first time. In the second order of the perturbation theory the corrections for mass and charge of electron are obtained as follows: $(\delta m/m) = (3\alpha/4\pi) \ln (1/lm)^2 + O((lm)^2 \ln (lm)^2)$, and $(\delta e/e) = -(\alpha/6\pi) \ln (1/lm)^2 + O((lm)^2 \ln (lm)^2)$. The procedure for securing the gauge invariance of the theory is established. The problem of the equivalence theorem is discussed. Finally the system of equations for propagators of electron and photon is obtained and the physical meaning of the two renormalization constants Z and Z_1 is discussed. (auth)

14285 NEUTRAL SCALAR FIELD THEORY WITH A POINT SOURCE. Nagamachi, S.; Mugibayashi, N. (Kobe Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 1, 329-340(Jan 1973).

The theory of neutral scalar field in interaction with a point source is studied exhaustively in the light of the algebraic formulation of quantum field theory. Emphases are laid on observing again the case of an extended source from the present viewpoint, and exhibiting the equivalence of two definitions of the renormalized Hilbert space by GNS construction and by infinite tensor product. (auth)

14286 FEYNMAN RULES FOR THE HIGGS MODEL. Nishijima, K. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 1, 341-344(Jan 1973).

It is pointed out that most of the effective Lagrangians used in the modified Dyson formula can be derived without recourse to the transcendental functional integration technique but from the canonical quantization method by recognizing properly the difference between the T and T* products of field operators. The Higgs model is used to illustrate the method. The theory is quantized in the canonical formalism and the functional differential equations obeyed by the generating functional as well as the S matrix as a formal solution to these equations are derived. Also the study of the physical significance of the extra term proportional to $i\delta^4(0)$ in the effective Lagrangian is treated. (JFP)

14287 PHYSICAL ANALYSIS ON THE COVARIANCE OF QUANTUM FIELD THEORY. Wan, K. K.; Derrick, G. H. (Univ. of St. Andrews, Fife, Scotland). Acta Phys. Pol.; B4: No. 3, 357-366(1973).

A model field theory is proposed especially for the study of general covariance. A detailed analysis is given on the determination of physical states, the role of coordinate conditions and the fundamental differences between a generally covariant theory and a Lorentz covariant one. (auth)

14288 INDEFINITE-METRIC QUANTUM THEORY OF GENUINE AND HIGGS-TYPE MASSIVE VECTOR FIELDS. Nakanishi, N. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 2, 640-651(Feb 1973).

On the basis of the indefinite-metric vector field theory proposed previously, Johnson's proposition that the physical mass of a vector field tends to zero as its bare mass goes to zero, is shown to be valid if the vector field couples with a charged scalar field in the minimal interaction. In the case of the theory of spontaneously broken gauge invariance, the reason why the vector field acquires a nonzero mass in spite of the above theorem is clarified. The theory of a vector field which is massive owing to the spontaneous breakdown of gauge invariance is consistently formulated in the framework of the indefinite-metric quantum field theory. In this formalism, both renormalizability and the unitarity of the physical S-matrix are self-evident. (auth)

14289 ESSENTIAL SELF-ADJOINTNESS OF DIFFERENT ALGEBRAS OF FIELD OPERATORS. Lassner, G.; Timmerman, V. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 15: No. 3, 311-314(Jun 1973). (In Russian).

It is proved that any On*-algebra generated by a Wick polynomial of the free field and the number operator is essentially self-adjoint. (auth)

14290 CONSTRUCTING THE DRESSING TRANSFORMATION IN THE LEE MODEL. Piskunov, V. N. Teor. Mat. Fiz.; 15: No. 3, 315-319(Jun 1973). (In Russian).

An arbitrary sector of the Lee model with relativistic energies of the V-, N- and θ-particles is considered. For this model, using the scheme due to L. D. Faddeev, the unitary dressing transformation is constructed, which separates the effects of the scattering from those of the self-interaction. (auth)

Gravitation and General Relativity

Refer also to abstracts 13447, 13645, 13687, 14280, and 14281.

14291 CORRESPONDENCE PARADOX IN GENERAL RELATIVITY. Yilmaz, H. (Perception Technology Corp., Winchester, MA). Lett Nuovo Cim.; 7: No. 9, 337-340(30 Jun 1973).

A new gravitational theory is formulated on the basis of the equations: $R_\mu^\nu = \frac{1}{2}\,\delta_\mu^\nu R = 8\pi(\sigma U_\mu U^\nu + t_\mu^\nu/4\pi)$, $d^2x_\mu/ds^2 = \{^{\alpha}_{\mu\beta}\}U_\alpha U^\beta$, and $\partial_\nu(\sqrt{-g}\sigma U_\mu U^\nu) = 0$ where t_μ^ν is the stress-energy of the gravitational field. The last condition is imposed to secure the correct correspondence requirement of four-momentum at the limit of special relativity. This condition may also be interpreted to imply that matter acts as a conserved tensor source of a symmetric gravitational field. The theory satisfies both the theoretical and experimental requirements at least in the first and second order of small quantities. It is also shown that if a certain equation from the Einstein theory were taken seriously the mass-energy relation and the red-shift formula would lead to a paradox. (JFP)

14292 EQUATIONS FOR A SPIN-TWO FIELD FROM A DIRAC-LIKE EQUATION. Doria, F. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Lett. Nuovo Cim.; 7: No. 5, 153-154(2 Jun 1973).

It is shown that a system of equations for a spin-two field can be obtained from a Dirac-like equation with the help of a formalisms within C_4, the Clifford-Dirac algebra. (LBS)

14293 THEORY OF GRAVITATION INCORPORATING THE QUADRATIC ACTION PRINCIPLE OF RELATIVITY. Wynne, V. A. (Memorial Univ. of Newfoundland, St. Johns); Derrick, G. H. Nuovo Cim.; 15B: No. 2, 181-209(11 Jun 1973).

The hypothesis adopted is that any permissible metric field whatsoever must satisfy some self-contained set of field equations for the metric tensor $g_{\rho\sigma}$. The adoption of such a hypothesis is motivated by the precariousness of the general-relativistic interpretation of Mach's principle, which is often used to justify a phenomenological approach to the theory. The fundamental equations of the gravitational field are provided in this instance by an action principle in which the Lagrangian is quadratic in the components of the Riemann tensor, viz. $R_{\rho\sigma}R^{\rho\sigma} + \beta R^2$, thus ensuring consistency with standard relativity theory based on Einstein's vacuum equations. The set of relations $R_{\rho\sigma} - \frac{1}{2}g_{\rho\sigma}R = -\chi T_{\rho\sigma}$ is retained as the definition of the matter tensor $T_{\rho\sigma}$. Attention is concentrated on the solutions of the (generally fourth-order) fundamental field equations in the static, spherically symmetric case. It is shown that under these symmetry conditions there are no asymptotically flat solutions with nonzero Riemann scalar, and no regular solutions with nonconstant Riemann scalar. Sets of exact solutions of the field equations are presented. (auth)

14294 GRAVITATIONAL RADIATION OF A RELATIVISTIC PARTICLE MOVING ALONG A CIRCLE. Khalilov, V. R.; Loskutov, Ju. M.; Sokolov, A. A.; Ternov, I. M. (Moscow State Univ.). Phys. Lett.; 44A: No. 3, 217-218(4 Jun 1973).

The spectral-angular distribution and the polarization are studied of the gravitational radiation of a relativistic particle moving along a circle. (auth)

14295 DYADIC APPROACH TO THE GENERAL THEORY OF RELATIVITY. Polishchuk, R. F. (All-Union Scientific Research Inst. for Physical-Technical and Radiotechnical Measurement, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 1, 76-79 (1 Mar 1973). (In Russian).

The form of curvature assigned to the Lorenz multiform V^4 determines the predominant fields of one-dimensional and two-dimensional directions. Dyadic formalism was used to develop the Riemann geometry of distribution V_2^4 in space-time V^4. (KSW)

14296 NONPERMANENCE OF THE CHANGE IN FOUR-MOMENTUM OF THE GRAVITATIONAL FIELD OF AN ISOLATED RADIATING SOURCE. Rotenberg, M. A. (Univ. of Wisconsin, Kenosha). J. Phys., A (London); 6: No. 6, 783-795 (Jun 1973).

The well known use of the Einstein energy pseudo-tensor density t_k^i for determining the rate of change of four-momentum, by gravitational radiation, of an isolated cohesive source in motion contains an important assumption: the total potential four-momentum of the gravitational field, represented by the integral of t_k^i over all space, undergoes no secular variation. A mathematical justification of this assumption is presented. However, an example is discussed in which consideration must be given to the variation of the total potential three-momentum of the field, despite the nonpermanence of this variation: namely the cyclic motion of the Newtonian centre of mass of a bounded,

cohesive, purely rotating system. Finally it is shown that replacement of the Einstein pseudo-tensor density by that of Landau and Lifshitz (The Classical Theory of Fields. (Oxford, Pergamon Press, 1962)) has no effect on the main results. (auth)

14297 PHYSICAL INTERPRETATION OF THE BEL–ROBINSON TENSOR. Garecki, J. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 3, 347-351(1973).

Expansion of the Einstein canonical pseudotensor, $E^{t}{}_{\mu}{}^{\nu}$, for the gravitational field in the normal coordinate system in vacuum shows that the first generalized normal tensor, $E^{t}{}_{\mu}{}^{\nu}{}_{\rho\sigma}$, belonging to the $E^{t}{}_{\mu}{}^{\nu}$ contains the Bel–Robinson tensor. It is therefore possible to connect some components of that tensor with the variations of the energy and momentum of the free gravitational field. (auth)

14298 HAMILTONIAN OF A PARTICLE IN RELATIVISTIC MECHANICS. Udeschini, P. Ann. Mat. Pura Appl.; 84: 113-124(1970). (In Italian).

In the framework of the general relativity, the Hamiltonian is constructed for a particle moving freely (i.e., only under the influence of gravitational forces), taking the proper time of the particle or the length of arc of its world line as an invariant parameter. (tr-auth)

14299 COVARIANT CONSERVATION LAWS IN GENERAL RELATIVITY THEORY. Gottlieb, J.; Mociutchi, C. An. Stiint. Univ. Al. I. Cuza Iasi, Sect. Ib. Fiz.; 17: No. 2, 105-110(1971). (In French).

The physical phenomena and their observation in the $v_n \times v_n$ space are described because the observor may be situated in a certain point of the v_n space. The integral tensor is determined by using the bitensor of transport and hence Stokes' formulas are written. Gauss' formula is generalized and a conservation covariant law is obtained. (tr-auth)

14300 EQUILIBRIUM OF CHARGED SPINNING MASSES IN GENERAL RELATIVITY. Israel, W.; Spanos, J. T. J. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 7: No. 7, 245-249 (16 Jun 1973).

Stationary interactions of spinning charges are studied within the formalism of Perjes, Israel, and Wilson (PIW). The PIW fields, which are interpreted as electromagnetic vacuum fields, are examined for both exterior and interior geometry. It is concluded that any configuration of PIW sources having arbitrary masses and angular momenta can be held in equilibrium without external struts. One possible interior extension of the PIW fields is presented. (LBS)

14301 DEGENERATE GRAVITATIONAL FIELDS WITH TWISTING RAYS. III. Zund, J. D. (New Mexico State Univ., Las Cruces). Lett. Nuovo Cim.; 7: No. 7, 233-234(16 Jun 1973).

An investigation of special classes of degenerate static vacuum gravitational fields with twisting rays is continued. A solution to the field equations is obtained which is distinct from the previously known twisting generalizations of the Schwarzschild solution. (LBS)

14302 ENERGY CONSERVATION AND THE QUESTION OF ITS LOCALIZATION IN STATIC RIEMANNIAN SPACE–TIMES. Moss, M. K.; Davis, W. R. (North Carolina State Univ., Raleigh). Lett. Nuovo Cim.; 7: No. 8, 282-284(23 Jun 1973).

It is shown that the energy of a static, spherically symmetric mass distribution is localized within a given and well-defined radius where $R_{ij} \pm 0$. It is shown that these particular Riemannian spaces admit a type of Gauss law in direct analogy to Newtonian gravitational theory. Some additional conclusions and analogies are drawn for the case of static, spherically symmetric, closed gravitational systems including charge. Results relating to the axially symmetric spinning solution of Einstein's field equation (Kerr metric) are briefly mentioned. (LBS)

REACTOR TECHNOLOGY AND REGULATION

14303 INDUSTRIAL AND EDUCATIONAL NEEDS: THE ROLE OF THE UNIVERSITY. Poncelet, C. G. (Carnegie-Mellon Univ., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 18 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14304 ROLE OF STANDARDS IN TEACHING NUCLEAR REACTOR DESIGN. Sesonske, A. (Purdue Univ., Lafayette, IN). Trans. Amer. Nucl. Soc.; 16: 22(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14305 TEACHING PRACTICAL REACTOR DESIGN METHODS AT THE UNDERGRADUATE LEVEL. Rydin, R. A.; Williamson, T. G. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 16: 27-28(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14306 FUEL MANAGEMENT IN POWER REACTORS. Fuel Management and Refuelling Schemes. Critoph, E. (Chalk River Nuclear Labs., Ont.). pp 201-220 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordanov, J. (ed.). Vienna; International Atomic Energy Agency (1973).

Some of the general scheme adopted for fuel management in operating power reactors are reviewed. The importance and scope of fuel management are discussed. The bases on which different fuel management schemes for a given reactor can be compared are analyzed. The general approaches which are employed in studying fuel management schemes and some of the problems which arise are described. (JWR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 14595, 14633, 14639, 14858, 14862, 14864-14867, 14873-14876, 14878, 14879, 14881, 14882, 14884-14888, 14894-14896, 14900, 14911-14913, 14917-14919, 14928-14931, 14933-14936, 14944, 14948-14951, 14954, 14968-14977, and 14989-15001.

14307 (EUR-4820(Vol.2)(Pt.D), pp 47-59) CONSIDERATION ON THE MECHANICAL DESIGN OF COMPONENTS OF BWR-FUEL ELEMENTS 64 RODS TYPE. Farello, G. E. (CNEN-CSN, Casaccia, Italy). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A description of the basic criteria followed during the design of mechanical components for BWR fuel assemblies is given. These criteria are mainly mechanical and permit one to obtain some stresses that must be compared with the allowable maximum nuclear ones. (auth)

14308 (EUR-4820(Vol.3)(Pt.E), pp 277-293) FUEL ROD VIBRATIONS INDUCED BY COOLANT FLOW. Federico, A.; Grillo, P. (CNEN, Rome). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A theoretical study of rod bundle vibrations induced by a coolant flow parallel to the rods was made as a support to mechanical design of fuel assemblies for light water reactors. Mention is made to the experimental tests carried out on fuel assembly prototypes in isothermal and adiabatic conditions in order to compare predicted and measured data. The application of this analysis to the design criteria for spacers of mechanically assembled fuel bundles is discussed. (auth)

14309 (EUR-4820(Vol.4)(Pt.G), pp 295-316) COMPUTATIONAL METHODS FOR PREDICTING TAPERED HUB BEHAVIOR IN LARGE-DIAMETER, HIGH-PRESSURE VESSEL FLANGES. van Campen, D. H. (Delft Univ. of Tech., Netherlands). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A comparison is given for alternative computational methods for tapered hub behavior in large-diameter, high-pressure vessel flanges using a finite element analysis for reference. These existing methods consider the hub either as a thin cylindrical shell with linearly varying thickness or as a ring with undeformable radial cross section. An improved version of the thin shell approaches is presented for large values of the taper angle, while the influence coefficients for the finite element approach are given in graphical form. 19 references. (auth)

14310 (EUR-4820(Vol.4)(Pt.H), pp 319-352) PRESTRESSING AND PROOF PRESSURE TESTING OF THE WYLFA PRESTRESSED-CONCRETE PRESSURE VESSELS AND COMPARISON OF MEASURED DATA WITH PREDICTED PERFORMANCE. Carlton, D. (Taylor Woodrow Construction Ltd., Southall, Eng.); Smith, J. R.; Bellwood, G. N. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The performance of the two prestressed concrete pressure vessels built for Wylfa Nuclear Power Station, when subjected to prestress and proof pressure loadings, provided the first comprehensive opportunities to judge both the design assumptions and the analysis employed. The analytical approaches adopted for the vessel design and the background experimental work undertaken to establish the necessary basic parameters of the concrete and prestress system are described. Brief details are also given of the in situ tests which confirmed the design values of the parameters. Each of the vessels was provided with extensive instrumentation to observe strains, deformations and temperatures, and these were monitored during prestressing and the cold proof pressure tests. The results of all this work are examined in comparing the behaviour of both vessels with each other and with the analytical predictions. Sources of error are identified and discussed. General conclusions are drawn on the overall degree of correlation achieved. (auth)

14311 (EUR-4820(Vol.4)(Pt.H), pp 477-494) SCANDINAVIAN PCRV MODEL PROJECT: STRESS CALCULATION AND EXPERIMENTAL VERIFICATION. Andersen, S. I. (Danish Atomic Energy Commission, Risoe); Hamre, E.; Tarandi, T. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Part of a joint development program by Denmark, Finland, Norway and Sweden in the field of prestressed concrete vessels for water reactors is described. PCVR's for water reactors are characterized by their relatively high ratio of wall thickness to radius and, in the Scandinavian design, by a removable top closure that permits refuelling to be done in the traditional LWR manner. The results of the theoretical and experimental structural analysis obtained during testing of the Scandinavian PCRV model vessel at Atomenergi, Sweden are presented. Testing of the model vessel showed good agreement with theoretical predictions. (auth)

14312 OPPORTUNITIES FOR UNIVERSITY RESEARCH IN LIGHT WATER POWER REACTOR TECHNOLOGY. Dietrich, J. R. (Combustion Engineering Windsor, CI). Trans. Amer. Nucl. Soc.; 16: 18-19(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14313 NUCLEAR FUEL PERFORMANCE IN OYSTER CREEK. Cherry, B. H. (GPU Service Corp., Parsippany, NJ); Denning, R. F.; Sullivan, J. L.; Zodiaco, V. P. Trans. Amer. Nucl. Soc.; 16: 101-102(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14314 TRENDS IN BWR FUEL PERFORMANCE. Klepfer, H. H.; Trocki, T. (General Electric Co., San Jose, CA). Trans Amer. Nucl. Soc.; 16: 104(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14315 CORROSION PRODUCT DEPOSITS ON FUEL AT THE NINE MILE POINT BWR. Blok, J.; Sawochka, S. G.; Snyder, D. T. (General Electric Corp., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 116(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14316 INTEGRAL CONTROL ROD PREDICTIONS FOR A BWR. Tramm, T. R. (Commonwealth Edison Co., Chicago); Lewis, E. E. Trans. Amer. Nucl. Soc.; 16: 171(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14317 COMPUTER PROGRAM FOR CONTROL ROD PROGRAMMING OF BWR. Motoda, H.; Kiguchi, T.; Kawai, T. (Hitachi, Ltd., Kawasaki, Japan). Trans. Amer. Nucl. Soc.; 16: 171-172(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14318 LIGHT-WATER REACTOR COOLANT ACTIVITY MONITOR BASED ON Ge(Li) DETECTOR. Graham, K. F.; Bestoso, W. J.; Forker, J. M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 237-238(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14319 BURNOUT LOCATION ON 16-ROD, 12-FT BWR BUNDLE. Lucchini, F. (CISE, Milan); Marinelli, V. Trans. Amer. Nucl. Soc.; 16: 250(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14320 SIMPLE BUT ACCURATE METHOD FOR PREDICTING BURNOUT IN BWR ROD BUNDLES. Marinelli, V.; Pastori, L. (CNEN, Rome). Trans. Amer. Nucl. Soc.; 16: 250-253(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14321 RADIOACTIVE OPERATIONS IN THE DISMANTLING OF THE ELK RIVER REACTOR. Nemec, J. F. (United Power Association, Elk River, MN); Beckers, R. M.; Blumberg, R. Trans. Amer. Nucl. Soc.; 16: 260(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14322 ANALYSIS OF BWR FUEL ASSEMBLIES CONTAINING GADOLINIUM AS BURNABLE POISON. Haugset, K. (Institutt for Atomenergi, Kjeller, Norway); Naess, H. K.; Skardhamar, T.; Brand, P. Trans. Amer. Nucl. Soc.; 16: 283-284(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14323 RADIATION LEVELS AND SHIELDING AT THE NINE MILE POINT BWR. Burns, R. A. (Niagara Mohawk Power Co., Lycoming, NY). Trans. Amer. Nucl. Soc.; 16: 331-332(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14324 STUDIES OF RADIATION SHIELDING FOR BOILING WATER REACTOR SYSTEMS. Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, TX); Warman, E. A. Trans. Amer. Nucl. Soc.; 16: 332-333(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14325 DYNAMICS OF POWER REACTORS. HYDRODYNAMIC MODELS OF BOILING CHANNELS. Lunde, J. E. (OECD Halden Reactor Project, Halden, Norway). pp 235-240 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordanov, J. (ed.). Vienna; International Atomic Energy Agency (1973).

The main considerations and structure of models currently used for the theoretical analysis of the hydrodynamic behavior of boiling channels in nuclear reactors are reviewed. (JWR)

14326 METHODS FOR THE REDUCTION OF RADIOACTIVE DISCHARGES FROM BOILING WATER NUCLEAR POWER PLANTS. Kausz, I. A.; Spang, A. (Siemens AG, Erlangen, Ger.). (1973). vp. (In German).

From VGB conference: power plant and environment, 1973; Essen, Germany (27 Feb 1973).

Gaseous and liquid radioactive discharges from reactor plants have to be decontaminated before they are released into the environment. A number of approved basic methods and improved systems to be applied for BWR reactor plants are presented and discussed with respect to their application and efficiency. (GE)

14327 FIRST CORE DESIGN OF THE BWR USING ENRICHMENT GRADUATION. Pleuger, D.; Bleckmann, A. (1973). vp. (In German).

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

A proposal was made for the distribution of fuel rods of different enrichments in order to balance the non-uniform burnup of an evenly fueled first core. This special distribution is the result of diffusion and burnup calculations and in spite of a shorter cycle will increase the total first core burnup. (GE)

14328 CRITICAL CALCULATIONS FOR THE NUCLEAR POWER STATIONS, KWO AND KWL. Lutz, D.; Havranek, M. (Univ., Stuttgart). (1973). vp. (In German).

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

An effort is made to theoretically reproduce the measured reactivity worths, starting from basic cross section data. (GE)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 14309, 14312, 14318, 14328, 14575, 14589–14591, 14605, 14633, 14638, 14639, 14643, 14661, 14844, 14857, 14859–14861, 14863, 14868–14872, 14880, 14883, 14889–14893, 14897–14899, 14901–14910, 14914–14916, 14920–14927, 14932, 14937–14943, 14945–14947, 14952, 14953, 14956–14967, and 14978–14988.

14329 (EUR-4820(Vol.3)(Pt.E), pp 353-369) VIBRATION TESTS ON REACTOR INTERNALS AND COMPARISON OF THE MEASUREMENTS WITH SIMPLIFIED ANALYTICAL INVESTIGATIONS. Pink, W. (Siemens AG, Erlangen, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Elaborate and expensive analytical work making use of modern computing techniques is required for investigating the dynamic behavior of such complex structures as reactor internals. The reliability of such calculations as needed for the analysis of the response of such components due to flow-induced vibrations, earthquakes and maximum credible accidents depends on the models, especially how the actual structure is simplified and which uncertainties are connected with this procedure. Vibration tests were therefore performed at the manufacturer's plant to ensure the accuracy demanded for the above mentioned studies and to prevent unnecessary refinements of the analytical techniques. A summary of such typical measurements on PWR internals is given. As a special example the analytical determination of the dominant eigenfrequencies for a system of a core-support plate is discussed and referred to the analysis of a homogeneous circular plate the boundary of which is supported on massless elastic springs. Comparison of the calculated with the measured frequencies is made. In addition to this it is shown that the dominant natural frequencies due to the mode shapes of bending waves on the core barrel shell can be calculated according to the Timoschenko theory of transverse beam vibrations by taking into account the effect of shear. Some of the calculated frequencies could also be compared with measured frequencies. The influence of concentrating the distributed masses into lumps on the calculation of eigenfrequencies is also discussed. (auth)

14330 (EUR-4820(Vol.3)(Pt.E), pp 371-394) PROGRAM SYSTEM FOR FAST CORRELATION AND SPECTRAL ANALYSIS OF LONG TIME SERIES OF POWER REACTOR SIGNALS. Gaffal, F. (Laboratorium fuer Reactorregelung und Anlagensicherung, Garching, Ger.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In order to investigate deterministic and random variations of reactor plant parameters, an extensive program was developed. For the time being, the system is utilized especially for investigating vibration problems of reactor internals. For this purpose, auto- and cross-correlation, power and cross spectra, transfer functions and coherence functions of stationary time series and confidence band for the spectra are computed. The time series can also be detrended and prefiltered or prewhitening can be applied. The program system consists of several digital analytic codes: a code which is based upon FFT; a code which calculates the correlation functions and the spectra; a code which is based upon filter methods; and a hybrid code. Incorporated in the system are utility programs for convenient input of analog data and distinct output of the results in tables and plots. In working out these codes, the main task had been laid upon easy and universal applicability, multiple inputs/outputs, short computing time and no restriction with regard to the amount of sampling points. A short characterization of the program is given. The advantages and disadvantages of the available codes with respect to different problems are discussed. Finally, some typical examples are shown and discussed. (auth)

14331 (EUR-4820(Vol.3)(Pt.E), pp 453-475) VIBRATIONS OF THE INTERNALS OF PRESSURIZED WATER REACTORS. Lazzeri, L.; Dini, D. (CNEN, Rome). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The problem of vibrations of internals typical of pressurized water reactors is examined. A method for the computation of the natural frequencies in the fundamental vibration mode in presence of water is presented. Some numerical examples for the geometry typical of PWR are given. About excitation the decisive influence of the geometry of the structure on dynamic response is shown and a computation model is proposed in the case of random broad band excitation. (auth)

14332 (EUR-4820(Vol.3)(Pt.F), pp 29-47) PREDICTION OF STRESSES AND FATIGUE STRENGTH OF A BOLTED CORE SUPPORT STRUCTURE. Manjoine, M. J. (Westinghouse Electric Corp., Pittsburgh); Keller, H. W. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The static and dynamic stresses for the bolts of a bolted core support structure are predicted from data obtained from model tests, operating experience and the characteristics of the structure determined by analytical programs. All significant loadings were considered. Peak stress intensities of the bolts were within the allowable stresses for the materials employed. Maximum oscillating stresses, calculated by assuming all sources in phase, were less than half the fatigue strength obtained from tests of bolts selected at random from production lots. A method for directly verifying the adequacy of the bolts under dynamic loading is described. In this method, standard production bolts, sharply notched to reduce their fatigue strength, are operated in the structure for all normal modes. Operation at each mode is of sufficient duration to ensure that the reduced-strength bolts will accumulate detectable damage if the alternating stresses are as great as the minimum endurance strength of standard bolts. If the reduced-strength bolts show no damage on post-operative inspection, then standard bolts are adequate for the life of the structure. (4 references) (auth)

14333 (EUR-4820(Vol.3)(Pt.F), pp 461-475) STRESS ANALYSES ON REACTOR CIRCULATION PUMPS. Stumpp, W. (Gebrueder Sulzer AG, Winterthur, Switzerland). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Extensive experimental and theoretical stress analysis has been done on geometrically similar housings and covers of reactor circulation pumps for cases of thermal as well as internal pressure. Two models of a prototype housing, one with a radial and the other with a tangential outlet had been examined by photo-elastic means when loaded under internal pressure. On a second housing, the finite-element method as well as strain gauges had been applied to determine the stresses due to internal pressure. Similarly the finite-element method has been utilized on a third housing and cover to calculate the stresses due to thermal loading and internal pressure. The housing and cover were calculated simultaneously by attaching the cover to the housing by means of circumferentially evenly spaced bar elements. It was further examined whether sliding between the mating faces of cover and housing could be prevented or not. (auth)

14334 (EUR-4820(Vol.3)(Pt.F), pp 497-516) CRITERIA AND DESIGN OF PRESSURIZED WATER REACTOR COOLANT SYSTEM SUPPORT STRUCTURES: STATE OF THE ART. Stevenson, J. D. (Univ. of Pittsburgh). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A survey of twenty-three U. S. reactor plant systems licensed for construction between 1 January 1967 and 30 Jun 1970 has been conducted to determine the current state of the art and to describe the resultant structural engineering practice used to design reactor coolant system support structures. Areas discussed are the structural design criteria, analytical assumptions, methods of analysis, resultant designs and quality control and fabrication procedures. (11 references) (auth)

14335 (EUR-4820(Vol.4)(Pt.G), pp 347-365) IMPORTANCE OF MATERIAL PROPERTIES IN THE DETERMINATION OF FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSELS. Klausnitzer, E. (Siemens AG, Erlangen, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

For stress calculations and safety analyses of reactor pressure vessels, a great number of material properties must be known. Reliable results can only be obtained with the applicable actual values, since empirical minima or mean values do not suffice. Cuts in the contemplated scope of testing must frequently be accepted because of the limited quantities of material available, tight schedules and budgets. Fundamental investigations, not tied to specific projects, are therefore considered to be of great importance. Depending on the computation models employed and the acceptance requirements set forth, different test methods are used. Recently, investigations into the fracture mechanics have gained in significance over the conventional methods of obtaining quantitative information on the fracture toughness. Wall thicknesses of reactor pressure vessels in pressurized-water reactors vary between 100 mm and 1,000 mm. With material in this order of thickness, different properties must be expected depending on the location and orientation of the specimen. Fundamental relations are disclosed. Recent test results obtained during systematic tests on actual pressure-vessel forgings are discussed. 6 references. (auth)

14336 (RT/FI-(73)9) ASSESSMENT OF THE RELIABILITY OF THE CNEN'S METHODS FOR THE NEUTRONIC DESIGN OF PWR'S. Part II. Analysis of (B. and W. Lumped Burnable Poison Program) Experiments. Gaafer, M.; Orestano, F.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 22 Mar 1973. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

The CNEN codes for the calculation of core configurations including boron absorbing cylinders for rod cluster control in present generation PWR's are described. As a further check of the reliability of CNEN codes a theory-experiment comparison was made with the measurements performed in the framework of the Lumped Burnable Poison Program of the Babcock and Wilcox Co., Lynchburg, for PWR cores in the presence of full and partial boron control clusters (both with B_4C and pyrex glass rods). (auth)

14337 (WAPD-332) SHIPPINGPORT OPERATIONS FROM INITIAL PWR CORE 2 POWER OPERATION TO POWER OPERATION AFTER FIRST REFUELING. Kemmet, L. H.; Werling, J. A. (eds.) (Bettis Atomic Power Lab., Pittsburgh, Pa; Duquesne Light Co., Pittsburgh, Pa). Jun 1973. Contract AT(11-1)-Gen-14. 211p. Dep. NTIS $12.75.

Shippingport Atomic Power Station PWR Core 2 Seed 1 lifetime experience is presented. Significant nuclear aspects are discussed; these include operating experience (e.g., highlights, incidents, maintenance, performance, refueling); reactor and reactor plant experience (e.g., accumulative reactor physics performance and thermal experience, reactor plant and component experience, and electrical and mechanical system experience and modifications); and radioactive contamination and waste disposal. The operations and experience associated with installing the second Core 2 seed fuel assemblies in the reactor vessel are highlighted. (auth)

14338 (WAPD-MRP-139) PRESSURIZED WATER REACTOR PROJECT. Technical Progress Report, July 26, 1972-January 25, 1973. (Bettis Atomic Power Lab., Pittsburgh, PA). 1973. Contract AT-11-1-GEN-14. 13p. Dep. NTIS $4.00.

Reactor operations and engineering aspects for the Shippingport Power Reactor are reviewed for the period from July 1972 to January 1973. Core 2 parameters are listed. Construction activities for the LWBR are described. (DCC)

14339 (WCAP-7809) CORE POWER CAPABILITY IN WESTINGHOUSE PWR'S. McFarlane, A. F. (Westinghouse Electric Corp., Pittsburgh, PA). Dec 1971. 26p.

If thermal and hydraulic feedback effects on fission power distribution in a three dimensional model are considered, a significant improvement in power capability can be obtained by comparison with previous conservative calculations. The steps necessary to determine the effects of the shape of the axial power distribution on power capability are illustrated by reference to a one-dimensional model. (auth)

14340 NUCLEAR FUEL EXPERIENCE IN WESTINGHOUSE PRESSURIZED WATER REACTORS. Ferrari, H. M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 101(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14341 FUEL PERFORMANCE OF INDIAN POINT UNIT NO. 1. Pezzello, J. A.; Lee, M. L. (Consolidated Edison Co., New York). Trans. Amer. Nucl. Soc.; 16: 102-103(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14342 PERFORMANCE RECORD AND DEVELOPMENT PROGRAMS FOR B AND W's PWR FUELS. Baroch, C. J.; Guay, A. E. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 16: 103-104(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14343 FUEL PERFORMANCE EXPERIENCE IN C-E AND KWU PRESSURIZED WATER REACTORS. Duncan, R. N. (Combustion Engineering Windsor, CT); Chernock, W. P.; Knodler, D.; Stehle, H.; Knaab, H. Trans. Amer. Nucl. Soc.; 16: 104-105 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14344 POWER FLATTENING AND LOADING PATTERN SEARCHES FOR PRESSURIZED WATER REACTORS. Howland, H. R. (Westinghouse Electric Corp., Pittsburgh); Dorny, C. N.; Stover, R. L. Trans. Amer. Nucl. Soc.; 16: 170-171(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14345 EVALUATION OF THE HYDRAULIC PERFORMANCE OF THE OPERATING REACTOR SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Fenech, H. (Univ. of California, Santa Barbara); Flournoy, W.; Shen, P. K. Trans. Amer. Nucl. Soc.; 16: 249-250(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14346 AT-POWER DYNAMICS TESTS IN A PRESSURIZED WATER REACTOR. Kerlin, T. W. (Univ. of Tennessee, Knoxville); Ball, S. J.; Katz, E. M.; Ali, M. R. Trans. Amer. Nucl. Soc.; 16: 301-302(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14347 SHIELDING DESIGN AND ANALYSIS METHODS FOR PRESSURIZED WATER REACTORS. Sapyta, J. J. (Babcock and Wilcox Co., Lynchburg, VA); Simmons, G. L. Trans. Amer. Nucl. Soc.; 16: 331(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14348 METHODS FOR THE REDUCTION OF RADIOACTIVE DISCHARGES FROM PRESSURIZED WATER NUCLEAR POWER PLANTS. Queiser, H. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main). (1973). vp. (In German).

From VGB conference: power plant and environment, 1973; Essen, Germany (27 Feb 1973).

An introductory survey of the source strength of the radioactivity and its propagation within the control area is presented. The engineering measures in the closed primary circuits and in the waste processing systems, which contribute to reducing the discharge, are discussed. A look at further development trends is given. (GE)

14349 CIRCULATION PUMPS DESIGN SOLUTIONS FOR PRESSURIZED WATER REACTORS. Bednar, J. (Zavody Jiriho Dimitrova, Blansko, Czech.). Jad. Energ.; 19: No. 6, 181-186 (Jul 1973). (In Czech).

The development of circulation pump designs is summarized with emphasis on parametric performance studies, particularly for high-speed pump operation. The technical and economic aspects of the various pump designs are compared. (auth)

14350 CONTAMINATION MONITORS FOR PERSONNEL MONITORING. Standardization of radiation monitoring in PWR-type nuclear power plants. Kuhn, L. (Kraftwerk Union AG, Erlangen, Ger.). Atomwirt., Atomtech.; 18: No. 5, 253-254(1973). (In German).

On the basis of the experience gained with the KWO, the most important changes of stationary contamination monitors in PWR-type nuclear power plants are discussed. These changes had to be made in order to comply with the new safety requirements for nuclear plants. (GE)

14351 ATLANTIC GENERATING STATION. Ashworth, J. A. (Public Service Electric and Gas Co., Jacksonville, FL). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 5(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 12809, 14635, 14778, and 14834-14837.

14352 (AE-472) AUTOMATIC SAMPLING STATION FOR FISSION GAS ANALYSIS. Sandklef, S.; Svensson, P. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Apr 1973. 51p. Dep. NTIS (U. S. Sales Only) $4.75.

In the irradiation testing of coated particle fuel for an HTR it has become increasingly important to supervise the irradiation behavior of the fuel. For this purpose an automatic sampling station for fission gas analysis has been designed at the Studsvik R2 reactor. The design principles, the associated equipment and the operating characteristics of the station are described. The methods for analysis of gamma spectra and calculation of fission gas release factors are given and the data treatment is outlined. The station has been in operation since 1971 and has shown itself to be a reliable source of valuable information on the fuel behavior. The principles of operation and analysis could well be applied to the task of supervising the cooling gas activity content of an HTR. (auth)

14353 (AEEW-R-858) CALCULATIONS OF THE THREE-DIMENSIONAL POWER DISTRIBUTION IN THE FORT ST. VRAIN REACTOR USING U. K. METHODS AND DATA. Anderson, D. W. (Atomic Energy Establishment, Winfrith (England)). Apr 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Assessments of the ability of U. K. methods and data developed primarily for the low enriched uranium cycle to simulate thorium cycle HTRs have been extended to cover reactivity and power distributions in commercial size reactors. The Fort St. Vrain 330 MW(e) HTR being built in the United States by Gulf General Atomic has been chosen as a convenient object for such a study since detailed design information together with the results of GGA's own calculations have been published. The results obtained are in good agreement with those obtained by GGA and indicate that both thorium and low enriched cycle HTRs can be adequately modelled with U. K. data and methods. (auth)

14354 (CEA-N-1570) NUCLEAR TESTS IN AIR FOR THE VANDELLOS POWER PLANT. Gomolinski, M.; Morier, F.; Menessier, D.; Pedel, A.; Duco, J.; Guelf, A.; Argant, C.; Bosser, R.; Brunet, M.; De Lapparent, D.; Le Ho, J. G. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Nov 1972. 84p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Various physical tests were carried out on the Vandellos power plant. Nuclear measurements were made in air in order to verify that the installation conforms with the design specifications. The measurements were carried out by the CEA in the framework of its obligation to the constructor. The program envisaged is indicated together with the experimental methods and the interpretation of the different tests. The predictions are confirmed by comparing the results of calculations and experiments. (FR)

14355 (EUR-4820(Vol.2)(Pt.C), pp 5-14) STRESS ANALYSIS OF COATED FUEL PARTICLES FOR DETERMINATION OF BURNUP BEHAVIOR IN HTR REACTOR. Bongartz, K. (Kernforschungsanlage, Juelich, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Stresses are induced into the coatings of a spherical coated fuel particle in a HTR mainly by dimensional changes of the material caused by the fast neutron flux and by fission gas pressure and swelling of the fuel material caused by burnup. By these stresses the lifetime of the fuel in the reactor is limited. Using a model established by H. Walther (SORIN) the lifetime of a multilayer particle for a power reactor was calculated. The calculation results indicate how the lifetime depends on the geometry of such a particle. Furthermore the results of an irradiation test with practically no burnup were compared with the calculation result. This led to an understanding of the mechanisms induced by the fast dose which most probably should have caused the disintegration of the particle in the test. (auth)

14356 (EUR-4820(Vol.2)(Pt.C), pp 15-33) THEORETICAL STUDY OF SPECIAL COMPACT MODELS IN VIEW OF THE IRRADIATION BEHAVIOR OF "BONDINGS" AND "COMPACTS" OF COATED FUEL PARTICLES. Drittler, K. (Kernforschungsanlage, Juelich, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In all high temperature reactors planned, built or under operation fuel particles are used. In order to prevent the escape of fission products these particles are coated with different layers of pyrolitic carbon or silicon carbide. Due to various reasons, mainly safety aspects, these coated particles (having a diameter in the range of 0.4 to 1 millimeter) are compacted. Under irradiation the particles and the matrix material generally have different length changes which cause internal stresses. During normal operation of power reactors these stresses can increase to an extent that the compact is destroyed. In order to get information on what properties of coated particles and matrix material have to be changed in order that internal stresses are

reduced to the lowest possible value, the internal stresses of compact models with spherical particles were calculated by analytical methods. It was assumed that the absolute value of the differences of the elastic properties of particles and matrix is not too large compared to that of the absolute values of the properties themselves. The evaluation of the derived formulas was done numerically. The results show that regarding the stresses there is only a weak influence of the geometrical dimensions and parameters. Besides other results the formalism can be used to calculate the irradiation behavior of some types of graphite (Gilsonite Graphite). (auth)

14357 (EUR-4820(Vol.2)(Pt.C), pp 35-48) STRESS AND STRAIN CALCULATIONS ON COATED PARTICLE FUEL AND COMPARISON WITH IRRADIATION RESULTS. Thomson, J. M. (Belgonucleaire, Brussels). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The use of a computer code, written for a spherical geometry and based on the mechanical and physical properties of the materials used for the coated particle fuel, enables one to predict and explain the mechanical behavior of the HTR fuel concept. (auth)

14358 (EUR-4820(Vol.2)(Pt.D), pp 63-79) FINITE ELEMENT ANALYSIS OF STRESSES IN FUEL ELEMENTS OF A HIGH TEMPERATURE GAS-COOLED REACTOR. Head, J. L.; Jezernik, A. (Imperial Coll. of Sci. and Tech., London). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A computer program is described, written to analyse the time-dependent stresses in prismatic fuel elements of a high-temperature gas-cooled reactor. Results are given of an analysis of the stress history of a teledial fuel pin throughout the life of the fuel pin in a reactor. (auth)

14359 (EUR-4820(Vol.2)(Pt.D), pp 81-95) STRESS ANALYSIS OF AN HTGR GRAPHITE FUEL ELEMENT INCLUDING RADIATION CREEP AND DIMENSIONAL CHANGES. Reynen, J.; Blanckenburg, J.; De Windt, P.; Putzeys, J. (EURATOM, Ispra, Italy). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A parametric study is presented concerning the stress evolution in an HTGR graphite fuel element in irradiation environment. Radiation induced creep is taken into account by a linear viscoelastic rheological model, considering elastic behavior, primary creep and secondary creep. The response to Wigner strains and to thermal dilatation strains is presented. A numerical example concerning a tubular graphite fuel element is included, making use of a two dimensional finite element code (ROTTEMP). (auth)

14360 (EUR-4820(Vol.2)(Pt.D), pp 97-113) ANALYSIS OF THERMAL AND IRRADIATION BEHAVIOUR OF FUELLED GRAPHITE BRICKS FOR A HIGH TEMPERATURE GAS COOLED REACTOR. Beckett, V. S. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The fuelled moderator bricks which structurally make up the core of the B.N.D.C. HTR design are described and analyses are given of the various design considerations necessary to ensure acceptable performance of the bricks with respect to their thermal and irradiation behavior. (auth)

14361 (EUR-4820(Vol.2)(Pt.D), pp 205-218) STRESS ANALYSIS OF SPHERICAL ELEMENTS OF AN HTR. Ehlers, K. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The analysis of the stresses in the spherical fuel elements of a helium cooled high temperature reactor during operation, which are generated by temperature gradients, irradiation induced shrinking of the graphite, nonsymmetrical heat generation and heat transfer conditions, and insertion of the control rods, is discussed. (auth)

14362 (EUR-4820(Vol.2)(Pt.D), pp 221-235) TEMPERATURE AND IRRADIATION INDUCED STRESSES IN THE GRAPHITE STRUCTURE OF THE THTR-300 MW(e) PROTOTYPE NUCLEAR POWER PLANT. Fritz, R. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Since Wigner changes are a function of neutron dose and of temperature and both of these are not uniformly distributed, this gives rise to differential strains. The stresses that these strains produce are, to some extent, relieved by the phenomenon of irradiation creep. They are to be superimposed to the stresses produced by short- and longtime temperature distribution. Problems involved in the calculation of those strains and stresses for the THTR-graphite structure are shown; the main results are discussed. (auth)

14363 (EUR-4820(Vol.2)(Pt.D), pp 237-252) CONSTRUCTION OF THE REACTOR STRUCTURES OF THE THTR-300 MW(e) PROTOTYPE NUCLEAR POWER PLANT AND ANALYSIS OF STRESSES CAUSED BY EXTERNAL LOADS. Beine, B. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.); Fritz, R.; Elter, C.; Brandes, K. Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The elements of the core structure have to withstand stresses from different external and thermal loads. The load conditions and the mechanical behavior as well as the idealized static systems for the core structure are described. The severest loads of the most important components of the core are presented. (auth)

14364 (EUR-4820(Vol.2)(Pt.D), pp 253-272) CORE WALL AND CORE BOTTOM LOADS IN A PEBBLE BED REACTOR DURING INSERTION OF CONTROL RODS. Merten, G. (Brown Boveri/Krupp Reaktorbau GmbH, Juelich, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The core of the Thorium-High-Temperature Reactor (THTR) has a cylindrical reflector wall and a conical bottom, both consisting of graphite material with a central outlet. It is filled up with a large number of spherical fuel elements of 6 cm diameter with a graphite shield. The absorber rod system developed for the THTR enables the free insertion of the rods into the pebble bed. In the upper zone of the pebble bed rods require a certain volume which is created by lifting the pebble bed like in a liquid. In the lower zone of the pebble bed the inserted volume of the absorber rods has to be made available by reducing the void volume. In this way pressure will be established in the reactor core. The knowledge of the pressure distribution within the pebble bed is of great importance with reference to the control rod system and to the graphite construction of the core wall and the core bottom. However, there are several parameters which influence the pressure distribution in the pebble bed, e.g., temperature, friction as a function of gas atmosphere, specific weight of the spheres and pressure losses of the streaming cooling gas along the pebble bed. The influence of these parameters can be described by an exponential law. The characteristic features of pressure distribution in bulk material which differ from those of liquids can be summarized as follows: (a) Dependence of pressure distribution on core height is not linear. (b) Pressure distribution is anisotropic. (c) Pressure distribution depends heavily on core geometry. (d) Pressure distribution depends on the history of the pebble bed. (e) Level surfaces of pressure are not horizontal plains as in a liquid but curved areas. (auth)

14365 (EUR-4820(Vol.3)(Pt.F), pp 49-62) CORE SUPPORT STRUCTURES FOR GAS COOLED REACTORS. Livsey, W. O. (GEC Reactor Equipment Ltd., Whetstone, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The change of style of core support for gas cooled reactors is reviewed, and the effects of the adoption of the prestressed concrete reactor vessel is outlined. The system of core support for the nuclear power station currently under construction at Hartlepool is considered in some detail, and the method of analysis is presented. The prospects of core support for higher temperature gas cooled reactors is considered. (3 references) (auth)

14366 (EUR-4820(Vol.3)(Pt.F), pp 401-416) DESIGN AND ANALYSIS OF THE HOT BOX PRESSURE DOME AND SKIRT FOR THE HARTLEPOOL REACTOR PRESSURE VESSELS. Tate, L. A. (British Nuclear Design and Construction Ltd., Whetstone, Eng.); Kendon, J. T.; White, W J.; Fagence, G. P ; Dener, Y. M. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The current designs of Advanced Gas Cooled Reactors, which embody reentrant gas flow to the core, require a membrane above the core to separate the cool, high pressure re-entrant gas flow from the high temperature, lower pressure gas in the hot plenum. The design of such a membrane, consisting of a highly perforated steel dome welded to the concrete pressure vessel liner via a cylindrical steel skirt, is described. Details of the stress analysis and of the theoretical and experimental thermal analysis are given. Two dome and skirt assemblies are presently being constructed at the twin reactor Hartlepool Nuclear Power Station. (11 references) (auth)

14367 (EUR-4820(Vol.3)(Pt.F), pp 417-436) PREDICTION OF THE ACOUSTICALLY INDUCED STRESS IN NUCLEAR GAS CIRCUIT COMPONENTS. Whitton, P. N.; Stearn, S. M.; Drake, M. E.; Worraker, W. S. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Failures have occurred in some of the U. K. power reactors due to fatigue of coolant gas circuit components induced by noise generated at the circulators and propagated around the circuit. To prevent expensive plant outages, it is necessary to demonstrate the integrity of the gas circuit structures at an early stage in the design. The theoretical methods which have been developed for this purpose are described. Where these methods are incomplete, suitable experimental procedures are described. (43 references) (auth)

14368 (EUR-4820(Vol.4)(Pt.H), pp 353-368) PRESTRESSED-CONCRETE PRESSURE VESSEL OF THE THTR-300 Mw(e) PROTOTYPE NUCLEAR POWER PLANT. Lotz, H.; Schwiers, H. G.; Schoening, J. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The first prestressed concrete pressure vessel for a nuclear plant in Germany will be constructed at the THTR-300 MWe-power plant. Information is given on the design and the calculations of the p. c. p. v. and its components, the linear, the cooling system, and the insulation. (auth)

14369 (EUR-4820(Vol.4)(Pt.H), pp 369-398) DESIGN OF POD BOILER PRESSURE VESSELS WITH PARTICULAR REFERENCE TO HARTLEPOOL NUCLEAR POWER STATION. Langan, D.; O'Flynn, M.; Welch, A. K. (Taylor Woodrow Construction Ltd., Southall, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Described are the design and development of the podded boiler type of prestressed concrete pressure vessel now being constructed for both the Hartlepool and Heysham Nuclear Power Stations in the United Kingdom. In this form of vessel two features of the reactor layout govern the vessel design: the adoption of a single channel fuelling arrangement with interstitial control rods and consequent close spacing of standpipes through the top cap of the vessel; and the housing of the boilers in the wall of the vessel. Prestressing of the top cap, therefore, has to be accomplished by circumferential tendons located outside the perforated zone. The second feature restricts the space available for internal hoop tendons and therefore external wire winding was adopted. The principal method used in analyzing the Hartlepool vessel and model, based on dynamic relaxation, is described. Various programs were developed in which plane stress and strain solutions were expressed in cartesian and polar co-ordinates. Additional programs using axi-symmetric and three-dimensional cylindrical co-ordinates were derived. An ultimate load analysis is introduced which shows the response of the vessel to overload pressures which would cause progressive cracking and rotation. The method is based on finding the collapse mechanism associated with the minimum potential energy in the vessel. Finally, the experimental program which has been conducted on a $1/_{10}$th scale model concrete vessel of the Hartlepool design is described. The essential experimental details, together with the degree of simulation achieved, are presented. The elastic response, overload and ultimate load behaviour of the model are then correlated with two methods of analysis described. (auth)

14370 (EUR-4820(Vol.4)(Pt.H), pp 465-476) MODEL OF THE BUGEY REACTOR PRESSURE VESSEL. Boisserie, J. M. (Electricite de France, Chatou). Mar 1972. (In French).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The first phase in the testing of this prestressed concrete pressure vessel was attained in the summer of 1971. During this phase and in the future results of careful stain measurements "in situ" will be compared with computed strains. The thermal properties and the creep of concrete have been simulated. First results have been obtained. (auth)

14371 (EUR-4820(Vol.4)(Pt.H), pp 495-511) THREE-DIMENSIONAL ELASTIC STRESSES IN THE REGIONS OF OPENINGS OF THE THTR PRESTRESSED-CONCRETE PRESSURE VESSEL: A COMPARISON OF NUMERICAL CALCULATIONS AND MEASURED VALUES OF AN ELASTIC MODEL. Hansson, V. (Ruhr-Univ., Bochum, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Today numerical calculations in three dimensions are carried out for complicated geometries. In consideration of assumptions for boundary conditions and the spacing of the computation net it was desirable to check what accuracy is obtained with numerical results for stress states in regions of complicated geometry. Measured strains of concrete models are influenced by the material behaviour of concrete and the construction of certain parts, so the accuracy of a computation method can be better checked by results obtained with an elastic model made of epoxy resin. Stresses were determined at the surfaces and inside the wall and plates of a model of the THTR-vessel made of epoxy resin. With this experimental investigation results of three-dimensional calculations were checked. The region with large horizontal and vertical openings near the junction of wall and plate was of greatest interest with this work. The computation with the dynamic relaxation method and the model test are described. Both results show good agreement and are discussed. (auth)

14372 (EUR-4820(Vol.4)(Pt.H), pp 513-534) MODEL TESTS FOR BETTER UNDERSTANDING OF THE LOAD BEHAVIOR OF THE PRESTRESSED-CONCRETE PRESSURE VESSEL FOR THE THTR-300 MW(e) PROTOTYPE NUCLEAR POWER PLANT. Lotz, H.; Meerwald, K. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Three model tests for the prestressed concrete pressure vessel for the THTR 300 MWe power plant are discussed. The PCPV will be tested with two concrete models, one full scale and one scaled at 1:5 and with a cast resin model scaled at 1:47. The top slab of the PCPV which contains numerous penetrations was tested as a partial model scaled at 1:20. (auth)

14373 (EUR-4820(Vol.4)(Pt.H), pp 535-549) THIN-WALLED 1:20 PRESTRESSED-CONCRETE PRESSURE VESSEL MODEL FOR THTR REACTOR TYPE. Scotto, F. L. (ENEL, Rome). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Preliminary information is given on tests performed on a 1:20 PCPV model for a HTGR type reactor. The model refers to an advanced design of a PCPV. This pressure vessel was developed and designed on the basic input data of a German THTR type pressure vessel. The peculiarity of this design consists in the thinning of the cylindrical walls, reduced to the thickness required for biological shielding. The tests have shown the reliability of the purposed solution that once reconfirmed by further experiments and investigations will lead to a money saving in the order of many million dollars. (auth)

14374 (EUR-4820(Vol.4)(Pt.H), pp 655-681) CALCULATION METHODS OF MULTI-LAYER INSULATIONS FOR HIGH-TEMPERATURE GAS REACTORS. Aranovitch, E.; Crutzen, S.; Dufresne, J.; Farfaletti-Casali, F. (Euratom, Ispra, Italy). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Calculation methods are presented for evaluating the heat losses in multilayer insulation systems with an emphasis on the natural convection aspect and for determining the optimal dimensions of the cells and number of layers. First, the case of a single cell is considered before dealing with the case of cells in series-parallel. The validity of the mathematical method is checked with the results of experimental tests. (auth)

14375 (EUR-4820(Vol.4)(Pt.H), pp 683-693) INVESTIGATION INTO STRUCTURAL BEHAVIOUR OF INSULATION OF THE PRESTRESSED-CONCRETE PRESSURE VESSELS OF WYLFA NUCLEAR POWER STATION. Williams, A. J. (British Nu-

clear Design and Construction Ltd., Whetstone, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In the design and development of insulation for the pressure vessels of gas-cooled reactors, difficulties arise in the simulation of dynamic loading conditions in the laboratory, and of their definition for the purpose of analysis. Experience at Wylfa has shown that under some conditions, and particularly where highly turbulent flow occurs, the stresses induced in the studs retaining insulation cover plates may be sufficiently high to cause fatigue failure. The course of events related to this situation, stress data obtained by measurement under reactor conditions, and tentative conclusions from the currently available data are presented. (auth)

14376 (EUR-4820(Vol.4)(Pt.H), pp 695-713) TEST SERIES FOR THE STUDY OF THE BEHAVIOR OF METALLIC INSULATION SYSTEMS IN HELIUM. von der Weyden, H. D. (Brown Boveri/Krupp Reaktorbau GbmH, Mannheim, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Although the behavior of certain metallic insulation systems in a fluid is known the behavior cannot be definitely transferred to another fluid, even if the processes responsible for the heat are generally known. In order to apply the insulation systems used in CO_2 to helium, these systems would have to be adopted to the special thermodynamic characteristics of helium. In order to find a safe design for the insulation of the THTR-300, the behavior of the insulation modified for the application in helium was investigated by helium atmosphere tests. The tests were carried out under the operating conditions of THTR-300. The total and local heat fluxes in the insulation were regularly repeated after temperature cycles, depressurisations, and pressurisations with regard to the expected operating conditions of THTR-300. The tests confirm that the modifications carried out on the original insulation system to achieve the adaptation to helium were appropriate. (auth)

14377 (EUR-4820(Vol.4)(Pt.H), pp 731-750) BASIS OF DESIGN OF LINERS FOR PRESTRESSED-CONCRETE PRESSURE VESSELS, AND PRACTICAL EXAMPLES OF THE APPLICATION OF THE DESIGN BASIS. White, C. M. (Whessoe Ltd., Darlington, Eng.); Albrecht, W. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The functions of a liner and the imposed conditions it is called upon to withstand are reviewed. Materials for construction and design concepts are considered. The various strains and restraints imposed on the liner are examined and the way in which they can produce interaction forces between the liner and the concrete vessel described. The distribution of these forces between liner attachments, the local redistribution of liner strains because of the deformation of these attachments under these loads, and the effects of liner buckling are considered. Having established the basic liner design to satisfy the operating conditions, the effect of various methods of construction on the overall cost and construction programme is discussed. Reasons are given for the various methods of construction used for the liners designed and built by Whessoe Ltd. and mention is made of service experience. (auth)

14378 (RD/B/M-2506) GAS-COOLED REACTOR HEAT TRANSFER: UNCLASSIFIED B. N. L. WORK 1966-1972. Lyall, H. G. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

A list, with abstracts, is presented of the available reports and papers published by CEGB Berkeley Nuclear Laboratories on work in the heat transfer field which is relevant to reactor development. Much of the work, although specific to the AGR can be applied to other reactor types such as the Gas-Cooled Fast Reactor. 36 items are included. (UK)

14379 AN INDUSTRY-DIRECTED THESIS: AXIAL FUEL SHUFFLING FOR AN HTGR. Hoppes, D. F. (Georgia Inst. of Tech., Atlanta); Johnson, R. J.; Brogli, R.; Shenoy, A. Trans. Amer. Nucl. Soc.; 16: 29-30(Jun 1973).

From 19th annual meeting of the American Nuclear Society: Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14380 RECENT IRRADIATION CAPSULE RESULTS ON HTGR FUELS. Harmon, D. P.; Hudritsch, W. W.; Alberstein, D. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 77-78(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14381 EFFECT OF IRRADIATION RESULTS ON THE GCFR PRESSURE EQUALIZATION SYSTEM (VENTING) DESIGN. Campana, R. J. (Gulf General Atomic Co., San Diego, CA); Lindgren, J. R.; Longest, A. W.; Conlin, J. A. Trans. Amer. Nucl. Soc.; 16: 109-110(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14382 TESTS OF ENHANCED HEAT TRANSFER SURFACES FOR ADVANCED GCFRs. Klepper, O. H. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 247-248(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14383 COMPUTER SIMULATION OF PULSED-NEUTRON EXPERIMENTS FOR THE FORT ST. VRAIN HTGR. Pfeiffer, W. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 288(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14384 DRY-TYPE COOLING TOWER FOR THE 300 MW THTR NUCLEAR POWER PLANT SCHMEHAUSEN-UENTROP. Hirschfelder, G. (Vereinigte Elektrizitaetswerke Westfalen AG, Dortmund, Ger.). (1973). vp. (In German).

From VGB conference: power plant and environment, 1973; Essen, Germany (27 Feb 1973).

Due to the difficulties arising from the supply of make-up water in cooling towers it has become necessary to study other types of condensation and cooling systems. The design of the dry-type cooling tower to be constructed for the 300 MW THTR plant Schmehausen-Uentrop can be regarded as a step into the future and will provide valuable information on the cooling system itself and on its influence on the functioning of the plant. (GE)

14385 SPACING OF FUEL ELEMENTS FOR NUCLEAR REACTORS. Kuzelka, V. (National Research Inst., Prague). Jad. Energ.; 19: No. 6, 187-195(Jul 1973).

The results of investigations concerning some problems of spacing and its components for fuel elements for nuclear reactors are presented. The problems of coolant aerodynamic force effects, stability limit, stresses, optimal dimensions and technology are considered. On the base of experimental values the influence of the spacing on characteristic properties of the fuel elements is demonstrated. The properties concerned are: the contact wear between the fuel cladding and spacing components, dynamic stresses in the cladding material and the effectiveness of the fuel elements. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 12974, 14445, 14577, 14583, and 14841.

14386 (EUR-4820(Vol.3)(Pt.E), pp 395-422) VIBRATIONS INDUCED BY THE TWO-PHASE (GAS + LIQUID) COOLANT FLOW IN THE POWER CHANNELS OF A PRESSURE TUBE TYPE NUCLEAR REACTOR. Cedolin, L. (Politecnico, Milan); Hassid, A.; Rossini, T.; Solieri, R. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

For the fuel element development of the CIRENE nuclear reactor, a detailed investigation has been undertaken on the power channel vibrational characteristics. The power channel consists of a vertical pressure tube (10.61 cm I. D.) containing eight 19 closely spaced rod bundles. Each bundle is 50 cm long and simply rests over the lower one. The coolant conditions (~50 bar pressure) vary between a few °C subcooling at the entrance and ~25% (by weight) steam quality at the exit. Some of the experimental results obtained with a two-phase two-component mixture (simulating the behavior of steam-water) flowing in an adiabatic out-of-pile circuit are presented. In particular the vibration of the pressure tube and the relative motion of the rod bundle with respect to the pressure tube were measured. A preliminary analysis of the results is presented. An attempt has been made to correlate the relative motion to the two-phase flow pressure fluctuations. Fluctuations of pressure difference along axis and around pressure tube

wall were measured and their relationship with the rod-bundle-pressure tube motion has been analyzed. (auth)

14387 (EUR-4820(Vol.3)(Pt.F), pp 107-127) INTERNAL SUPPORTING STRUCTURES OF PRESSURE TUBES TYPE REACTOR CORE: ANALYTICAL MODEL FOR STATIC ANALYSIS. Caruso, S.; Gasparini, L.; Palmero, A. (Progettazioni Mecchaniche-Nucleari S.p.A., Genoa). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An analytical-numerical method is presented for elastic static analysis of typical supporting structures of pressure tube type reactor core. The method is based essentially on the finite element technique and deals with tubes and shells by analytical approach. The idealization of the structures and the computer program used have been partially checked by strain-gauges measurements on a model of a part of the structures. (auth)

14388 (EUR-4820(Vol.3)(Pt.F), pp 365-381) DESIGN CRITERIA FOR THE CALCULATION OF A HOT CHANNEL IN A PRESSURE TUBE NUCLEAR REACTOR. Bernard, J.; Dufresne, J.; Farfaletti-Casali, F.; Putzeys, J. (EURATOM, Ispra, Italy). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Pressure tube materials, characteristics and life-time expectancy as a function of nominal and accidental operating conditions are considered. Statistical interpretation of creep tests is presented. Calculations of the wall thickness of a hot pressure tube are included. These results give the lower limit of the pressure tube wall thickness excluding wear and fabrication tolerances. (17 references) (auth)

14389 (EUR-4820(Vol.4)(Pt.H), pp 399-412) NOTE ON A PRESTRESSED-CONCRETE PRESSURE VESSEL FOR THE INSTITUTO DE PESQUISAS RADIOATIVAS. de Souza e Silva, R.; Pinheiro, R. B. (Instituto de Pesquisas Radioativas, Belo-Horizonte, Brazil). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Studies developed at the Instituto de Pesquisas Radioativas (UFMG/CNEN) concerning the prestressed concrete pressure vessel for a natural uranium heavy water moderated and cooled power reactor are described. The possibility of using Brazilian industry as much as possible was a determinant in the general aspects of the PCV project. For circumferential prestress the method of exterior high strength steel strips was adopted. A modified system of the Swedish approach for the top removable lid and the thermal insulation was adopted. The stress analysis was performed by a finite element program which uses TRIA-3 axisymmetric elements. Creep and shrinkage were also investigated. (auth)

14390 (EUR-4820(Vol.5)(Pt.J), pp 373-401) NUCLEAR CONTAINMENT STRUCTURES IN CONCRETE IN INDIA. Rao, M. S.; Kulkarni, N. N. (Dept. of Atomic Energy, Bombay). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A large number of secondary nuclear containment structures were initially built in steel. However, concrete shielding was still used around such steel containment shells from the consideration of radiation hazards. Economy can be achieved if concrete could be used to combine structural and shielding requirements. The present trend is more and more towards concrete containment structures both for the primary as well as secondary containments. The Govt. of India, Department of Atomic Energy, is constructing nuclear power reactors of the CANDU type as a first stage in its Nuclear Power Programme. Concrete (both the ordinary mild steel reinforced and prestressed) is being utilized for the secondary containment structures for two of the country's nuclear power projects i.e., Rajasthan Atomic Power Project and Madras Atomic Power Project. In the Rajasthan Atomic Power Project, the containment structure consists of a reinforced concrete cylindrical shell with a prestressed concrete dome designed for a low pressure. This is a modification over the original CANDU containment (in Canada) in which the dome was made of steel. In the Madras Atomic Power Project, the containment pressure was increased and prestressed concrete is being used for both the cylindrical shell and the dome. In addition to this, a double containment system is being evolved to control the leakage during MCA effectively. Thus it is a further modification in the CANDU containment system. The general approach to structural analysis etc., of the two containment structures is described in brief. (auth)

14391 (EUR-4820(Vol. 6)(Pt. L), pp 341-358) CREEP DEFLECTION OF PRESSURE TUBES IN HORIZONTAL REACTORS. Ross-Ross, P. A.; Pettigrew, M. J. (Chalk River Nuclear Labs., Ont.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The pressure tubes in the CANDU-PHW reactors are of zirconium alloys. They operate in the stress range of 14,000 to 18,000 psi (96 to 124 MN/m^2), at temperatures from 250 to 300°C, and in fast neutron fluxes up to $3 \times 10^{13} n/cm^2 s > 1$ MeV. In addition to the stress due to internal pressure, the tubes, which are horizontal, are subject to bending stresses induced by the weight of fuel, coolant, and tube. The creep deflection of the pressure tube is dependent on the structural behaviour of the fuel channel consisting of the pressure tube, a concentric calandria tube, end-fittings and spacers. Creep of zirconium alloys is accelerated by fast neutron flux and with time the pressure tubes will deflect and could touch the calandria tube, or could bow such that the radius of curvature at points of high bending moments could become too small for free passage of the fuel. Results from in-reactor measurements to determine creep behavior, the significance of anisotropic creep, the application of the creep data to the deflection analysis, and the results found for several reactor configurations are discussed. The general conclusion is that creep deflection is not likely to be life limiting for a pressure tube; the tube will reach a strain limit due to transverse creep first. (auth)

14392 CANADIAN FUEL PERFORMANCE. Robertson, J. A. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Page, R. D.; Bodie, L. L. Trans. Amer. Nucl. Soc.; 16: 102 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14393 CRITICAL EXPERIMENTS ON CLUSTER-TYPE FUEL LATTICES OF ATR IN JAPAN. Sakata, H.; Hachiya, Y.; Shiba, K.; Fukumura, N.; Nishi, A. (Power Reactor and Nuclear Fuel Development Corp., Ibaraki, Japan). Trans. Amer. Nucl. Soc.; 16: 267-270(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14394 DYNAMICS OF POWER REACTORS. The Effect of Reactivity Feedback on Hydrodynamic Stability in a Heavy-Water-Moderated, Boiling-Light-Water-Cooled Reactor. Critoph, E. (Chalk River Nuclear Labs., Ont.). pp 241-245 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordanov, J. (ed.). Vienna; International Atomic Energy Agency (1973).

An analysis of reactivity feedback effect on the hydrodynamic stability of the Gentilly reactor is described. (JWR)

Power Reactors, Breeding

Refer also to abstracts 12681, 12819, 13129, 13130, 14338, 14578, 14580-14582, 14584-14586, 14594, 14596, 14597, 14607-14609, 14611, 14613-14620, 14622-14626, 14628-14630, 14634, 14834, 14839, 14847, 14856, and 14877.

14395 (AI-AEC-13059) LMFBR PHYSICS PROGRAMS. Quarterly Technical Progress Report, January-March 1973. (Atomics International, Canoga Park, Calif.). 15 May 1973. Contract AT(04-3)-824. 12p. Dep. NTIS $4.00.

Research progress on the development of ENDF/B data files and the theory and computation for reactor analysis and design of importance to the LMFBR program is reported. (JWR)

14396 (ANL-7681) SWELL: A FORTRAN-II CODE FOR ESTIMATING LIFETIMES OF MIXED-OXIDE FUEL ELEMENTS. Bump, T. R. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-eng-38. 145p. AT $5.45.

The SWELL FORTRAN-II computer code is intended to provide fuel-element lifetime data for fast-reactor-power-plant optimization studies. Only cylindrical, gas-bonded, mixed-oxide elements are considered. The fuel is separated into a central, columnar-grain zone and a colder, peripheral zone. In each zone, fission-gas release depends on the velocity and distance-to-release of a typical gas bubble. The fuel-swelling pressure against the cladding is an empirical function of the pressure of retained fission gas. Either the fuel-swelling pressure or the plenum pressure, whichever is greater, is the effective pressure on the cladding inside diameter at any axial position. The cladding fails when its cumulative damage exceeds unity. Damage components are primary and secondary creep, ratcheting growth and fatigue from thermal cycling, and in-

exorable fuel-swelling strain. Periodically, the fuel element is subjected to abnormal conditions to determine whether they would cause failure. (auth)

14397 (BMFT-FBK-73-4) SODIUM-COOLED HIGH GAIN BREEDER. Reference-Study. Affeldt, B.; Amon, F.; Behme, K. H. (Allgemeine Elektricitaets-Gesellschaft, AEG-Telefunken, Grosswelzheim (West Germany)). Apr 1973. 395p. (In German). Dep. NTIS (U. S. Sales Only) $21.75.

Main goals of a study for a sodium-cooled high gain breeder were the choice of an optimized fuel element concept and a favourable core design incorporating different criteria. The reference concept has fuel pins with fission gas venting and sodium bonding. Compared to an oxide breeder it shows advantages in fissile inventory, doubling time and fuel cycle costs. The investigation of safety aspects resulted in favourable prospects for the carbide-fueled breeder. Promising development potential can be found by increasing the plant size up to 3000 MW(e). (auth)

14398 (BMFT-FBK-73-5) COMPACT SODIUM COOLED REACTOR PLANT KARLSRUHE. Project Linked Research and Development Programme. Part I. Report on the Works from 1.1.1969 Til 31.8.1969. Part II. Final Report on the Research Performed During the Period of the Project. (Internationale Atomreaktorbau G.M.B.H., Bensberg (West Germany)). Apr 1973. 54p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

Work performed in the frame of the project-linked Research and Development Program during January through August 1969 is explained. Work performed during the whole period of the project and the results are summarized. (auth)

14399 (CEA-N-1579) CALCULATION OF THE NEUTRON SPECTRUM IN THE LOWER PART OF THE PHENIX EXCHANGER USING TRIPOLI. Nimal, J. C.; Vergnaud, T. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 43p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

Results obtained from studies of the activation of the secondary sodium in an exchanger of the fast reactor, Phenix, are presented. Neutron diffusion beneath the radial neutron shield was treated using the general Monte Carlo program TRIPOLI. A comparison was made with a one-dimensional transport calculation NIOBE. The discrepancy between the results obtained with these two types of program justifies the use of a three-dimensional code for this type of problem. (FR)

14400 (CONF-710122-1) CORE RESTRAINT SYSTEM DESIGN AND ANALYSIS. Pennell, W. E. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). [nd]. 37p. Dep. NTIS $4.00.

The geometry of an LMFBR core must be closely controlled at all times with predictable and safe response to steady state and transient operating conditions. A restraint must be provided which will operate for long periods without maintenance and must be capable of accommodating uncertainties in core behavior. The system described has a complaint feature to allow for core geometry variations and a mechanical linkage to back off the restraint load for refueling. (FS)

14401 (CONF-710122-2) COMMENTS ON SOME LMFBR CORE DESIGN AND ANALYSIS PROBLEMS. Pennell, W. E. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). [nd]. 67p. Dep. NTIS $5.50.

The design of the core components must satisfy nuclear and thermal hydraulic performance requirements. Reliability is assured by obtaining an adequate understanding of the responses of the component structure to the in-reactor environmental and loading conditions. Detailed mechanical performance analysis backed by development testing is required to obtain this understanding. Irradiation induced swelling and creep, environmental effects on core structural materials, and pin bundle supports are investigated. (FS)

14402 (CONF-711009-16) PRESSURE DROP PREDICTION FOR FUEL ASSEMBLIES WITH A WIRE WRAP SPACER SYSTEM. Novendstern, E. H. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). [nd]. Contract AT(45-1)-2171. 28p. Dep. NTIS $3.50.

From joint meeting of the American Nuclear Society; Miami Beach, Florida, USA (17 Oct 1971).

A semi-empirical model is developed that can accurately predict pressure losses in a hexagonal array of fuel pins utilizing a wire wrap spacer system. The model is able to predict pressure drop to within ±14% over a wide range of geometries in the turbulent flow regime. The model compares favorably with independent pressure drop measurements, not used to obtain the correlation, made on a FFTF 217 pin fuel pin bundle with flowing sodium at 400 to 1100°F. A numerical example is presented using the new model. (auth)

14403 (CONF-730532-1) DEVELOPMENT OF HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS FOR LIQUID-METAL FAST-BREEDER REACTOR SYSTEM COMPONENTS. Pugh, C. E. (Oak Ridge National Lab., Tenn.). [nd]. 51p. Dep. NTIS $4.75.

From Seminar to the Department of Engineering Science, Mechanics and Aerospace Engineering; Gainesville, Florida, USA (25 May 1973).

The liquid-metal fast-breeder reactor systems are described and some attendant structural design problems associated with inelastic material behavior are discussed. Central features of the ORNL program to develop applicable structural design methods are outlined, including considerations of material deformation and failure. Activities to develop constitutive equations applicable to elastic-plastic and creep behavior are discussed and currently recommended methods described. Some basic features of inelastic behavior of pertinent materials (particularly type 304 stainless steel) are illustrated, along with the role they play in the development of constitutive equations. A number of elevated temperature structural tests are described, and selected comparisons of test results with analysis predictions are presented. (auth)

14404 (EUR-4820(Vol.2)(Pt.C), pp 75-88) MECHANICAL STRESS OF FUEL ROD CLADDINGS BY RADIAL AND AZIMUTHAL TEMPERATURE GRADIENTS IN FUEL ELEMENTS WITH AN ECCENTRICAL GEOMETRY. Fischer, M.; Hofmann, F.; Krieg, R. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A theoretical analysis of the temperature and elastic stress distribution in symmetrical and asymmetrical triangular rod clusters is presented. The analysis is applied to sodium as a coolant with fully developed turbulent flow. The temperature and stress analysis was carried out at axial sections where both the volume increase by swelling as function of temperature and temperature gradients in radial and peripheral direction lead to the critical conditions. Numerical results are presented for some specific cases (i.e. for a rod bundle with pitch to diameter ratio 1:21 and displacements $\xi = 0$; 0.1; 0.2 mm). The results show that already small displacements of the fuel rod in tightly packed rod bundles cause considerable temperature and axial stress variations in the cladding in circumferential direction. (auth)

14405 (EUR-4820(Vol.2)(Pt.C), pp 285-322) THERMAL, RADIATION, AND MECHANICAL ANALYSIS FOR FAST REACTOR FUEL ELEMENTS. Ma, B. M. (Iowa State Univ., Ames). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A thermal, radiation and mechanical analysis for long, cylindrical fuel elements of liquid-metal fast breeder reactors (LMFBR) is presented. Equations for temperature distributions and thermal gradients produced in the fuel elements are derived for given linear power densities. The radiation effects of thermal-cycling growth, irradiation growth and irradiation swelling are briefly discussed. A model of irradiation swelling, bubble movement and fission gas release is proposed. In the mechanical analysis, together with results obtained from the thermal and radiation treatments, an iteration method for a computer code ISUNE 1A is used to obtain stresses and strains of the fuel elements. Uranium-plutonium oxides (UO_2-PuO_2) are considered the present fuel material of LMFBR. In the thermal analysis the temperature distributions and thermal gradients developed in the columnar grain region, equiaxed grain region and unaffected grain region of fuel restructuring are derived. In the radiation analysis an irradiation swelling model correlating the basic concepts of fission-gas bubble nucleation, trapping, migration and collision are postulated. In the mechanical analysis, by combining results obtained from the thermal and radiation analysis, the stress and strain equations for the fuel elements of LMFBR are derived. A numerical example is introduced to illustrate application of all the derived equations. (auth)

14406 (EUR-4820(Vol.3)(Pt.E), pp 35-49) EXPERIMENTAL ANALYSES OF STRESS IN FUEL ELEMENT BUNDLES BY BOILING AND CONDENSATION PULSES IN SODIUM. Cramer, M.; Dorr, B.; Mueller, R. A. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Described are the first series of sodium boiling experiments performed on a full-sized fuel element of the DEBENELUX Fast Breeder Reactor which is presently in the final phase of design. These experiments relate to the general safety experiments car-

ried out with respect to sodium-cooled fast reactors. It was the aim of this work to obtain information about the boiling behavior of fuel-element bundles made of a large number of pins and, in particular, to investigate the stress conditions prevailing at the walls of the hexagonal fuel-element box. Boiling was initiated in two different ways: by heating of sodium under constant pressure up to the boiling temperature or, in case of delayed boiling, beyond the boiling temperature; and by rapid reduction of pressure after sodium heating to a predetermined temperature under increased pressure. During the boiling process the temperature distribution and the pressure behavior within the fuel-element bundle were recorded by an automatic data acquisition system. For some experiments, the characteristics of the boiling processes are discussed on the basis of measured results. The experiments showed that the pressure loading exerted through boiling and condensation impact on the wall of the fuel-element box is kept at such a low level that a destruction or unacceptable deformation of these parts should not be anticipated. (auth)

14407 (EUR-4820(Vol.3)(Pt.E), pp 223-242) EXPERIMENTAL ANALYSIS OF A COMPOSED STRUCTURE SUBJECT TO A DYNAMIC LOAD. Cenerini, R.; Curioni, S.; Holtbecker, H.; Milini, G.; Montagnani, M.; Simeone, P.; Verzeletti, G. (CNEN, Bologna). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Experimental results are given of a series of tests on the dynamic response of a structure subject to an explosive loading. The structure simulates the assembly of the vessel and external shields of the PEC sodium-cooled fast reactor in the case of an uncontrolled nuclear excursion. A theoretical interpretation of the phenomenon is provided. (auth)

14408 (EUR-4820(Vol.3)(Pt.E), pp 295-316) FLOW-INDUCED VIBRATIONS OF FUEL ELEMENTS OF FAST BREEDER REACTORS. Appelt, K. D.; Kadlec, J.; Krueger, W. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Comprehensive investigations into parallel flow-induced lateral vibrations of fuel pins of fast reactor subassemblies are briefly reviewed. The investigations described include: calculation of natural frequencies and normal modes, estimation of amplitudes, experimental investigations into the influences of spacer grids on normal modes and measurements of pressure fluctuations and corresponding vibrations of fuel pins in flowing water. Typical plots of normal modes, resonance curves, dependencies of rms-values of pressure fluctuations and of vibrating strains on flow parameters as well as the spectral density functions of these quantities, relating to investigations into fuel pin vibrations of the fast reactor subassemblies Na 1 or FR 3, are also presented. (auth)

14409 (EUR-4820(Vol.3)(Pt.F), pp 63-77) DESIGN ANALYSIS FOR LMFBR CORE RESTRAINT. Patterson, J. F.; Yant, H. W. (Westinghouse Electric Corp., Madison, PA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Liquid Metal Fast Breeder Reactor (LMFBR) core restraint concepts featuring both mechanical and hydraulic holddowns are described. The support and restraint designs from the loose "vase" type design to a highly restrained system with complex loadings are evaluated. Consideration of both steady state and transient thermal response along with irradiation induced materials effects is presented. Of the arrangements considered, systems featuring a high degree of restraint yield minimum end-of-life irradiation induced distortions but require higher loads on assembly structures. Systems which are loosely restrained yield lower loads but extremely high predicted thermal and irradiation induced distortions. All arrangements studied gave "worst case" transient thermal bows which were satisfactory from the standpoint of positive nuclear reactivity input over the total operating range. (auth)

14410 (EUR-4820(Vol.3)(Pt.F), pp 79-105) OPTIMIZATION STUDY FOR AN INTERNAL SUPPORTING FLANGE IN A NUCLEAR REACTOR VESSEL. Curioni, S.; Neri, P. (CNEN, Bologna). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An optimization study for the supporting flange of the core element grid in a nuclear fast reactor is presented. The influence of geometrical parameters on the range of the structure stresses is analyzed. Some consideration on the limits of applicability of the simplified theory of the axialsymmetrical rings is presented. (3 references) (auth)

14411 (EUR-4820(Vol.3)(Pt.F), pp 189-204) ELASTIC STABILITY OF HEXAGONAL SHELLS. Krajcinovic, D. (Argonne National Lab., IL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The linearized stability analysis of a subassembly fuel duct is presented. The method employed is based on the semimembrane theory of long prismatic shells. Closed form formulas are obtained for certain, most interesting, types of loading. (2 references) (auth)

14412 (EUR-4820(Vol.3)(Pt.F), pp 383-400) EXPERIMENTAL AND THEORETICAL STRESS ANALYSIS IN A NUCLEAR STEAM GENERATOR HEAD. Curioni, S. (Univ., Bologna); Favretti, G.; Freddi, A.; Garro, A. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A multiple approach for elastic stress analysis in a nuclear steam-generator head is presented. Two experimental techniques (photoelastic, electrical strain gages) are used for a first study and the solutions are compared with one another and with those derived from finite-element analysis. The importance of the application of different complementary experimental methods for prediction of stresses at discontinuities and for checking of the numerical program is shown. (5 references) (auth)

14413 (EUR-4820(Vol. 6)(Pt. L), pp 293-310) APPLICATION OF FINITE ELEMENT METHODS FOR THE ANALYSIS OF THERMAL CREEP, IRRADIATION INDUCED CREEP, AND SWELLING FOR LMFBR DESIGN. Swanson, J. A. (Swanson Analysis Systems, Inc., Elizabeth, PA); Patterson, J. F. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The finite element method provides a valuable tool for the analysis of the many interacting effects which occur in the design analysis of the Liquid Metal Fast Breeder Reactor (LMFBR). The material effects which are discussed include the usual elastic and thermal effects, thermal and irradiation induced creep, swelling due to the fast neutron fluence, and plasticity. In addition two different geometric effects are sometimes needed--large deflections and interface interactions. The methods which are used to treat these effects and their interactions are discussed. The application of these methods to actual LMFBR design analyses is illustrated. Included are examples of analyses of fuel rods and fuel assembly ducts. (auth)

14414 (EUR-4820(Vol. 6)(Pt. L), pp 359-371) CREEP ANALYSIS OF A PROCESS TUBE. Lin, T. H. (Univ. of California, Los Angeles); Anderson, D. R.; Anderson, W. F. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A process tube of a nuclear reactor cooled by liquid sodium, subject to a variation of temperature of 750°F to 1200°F and a variation of internal pressure along the length is analyzed. This tube made of 304 stainless steel, is designed for a life of 30 years. Based on creep data in terms of tensile stress vs temperature at creep ratios of 0.0001% and 0.00001% per hour, the stress vs. temperature for lower creep rates are extrapolated by hyperbole sine law. This uniaxial stress-strain-time relationship is generalized for multiaxial stress. The creep strain components are assumed to be proportional to the corresponding deviated stress components and a function of the second deviate stress invariant. The change of stress caused by the incremental creep strain is obtained by the analogy of creep strain gradient and the applied body force similar to Duhamel's analogy for thermal strain. The differential equation for the bending of the tube is written in finite difference form and solved with the aid of an IBM computer. The deflected curves and the maximum longitudinal stress of the process tube at different stages of its life are calculated and shown. (auth)

14415 (EURFNR-1054) FAST BREEDER PROJECT. Third Quarterly Report, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 207p. (KFK-1272/3; EUR-4849). Dep. NTIS $12.50.

Work performed under United States--Euratom Fast Reactor Exchange Program.

Research progress is reported for the following activities: fuel pin development; materials development; reactor physics and theory; fast reactor safety; instrumentation development; sodium technology; and design studies. (JWR)

14416 (EURFNR-1071) FAST BREEDER PROJECT. Fourth Quarterly Report, 1972. Hueper, R. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany)). Feb 1973. 222p. (KFK-1272/4). Dep. NTIS.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Research progress is reported for the following activities: fuel pin development; materials development; reactor physics and theory; fast reactor safety; instrumentation development; sodium technology; and design studies. (JWR)

14417 (EURFNR-1089) NISA I: A PROGRAM FOR CALCULATING COEFFICIENTS OF FRICTION IN ROUGH ROD BUNDLES IN HEXAGONAL ARRAY. Savatteri, C. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Mar 1973. 32p. (EUR-4848). Dep. NTIS $3.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A description is given of the NISA I computer program for calculation of friction coefficients in roughened pin bundles in hexagonal array. The NISA I program allows one to calculate the isothermal flow in pin bundles with any number of roughened pins. A description of the program, an explanation of the input data, and an example of computation are presented. To confirm the validity of the NISA I program, experiments were used which helped to determine the friction coefficients in pin bundles of hexagonal array. Good agreement was found to exist between the digitally computed and the measured friction coefficients. (auth)

14418 (GEAP-10028-45) SODIUM-COOLED REACTORS CORE ENGINEERING PROGRAM. Forty-fifth Quarterly Report, November 1972–January 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Mar 1973. Contract AT(04-3)-893. 210p. Dep. NTIS $12.50.

Progress is described for tasks related to fuel rods, fuel rod assemblies, core restraint, control and blanket assemblies, and defected fuel. (auth)

14419 (GEAP-10718) ANALYTIC STUDY OF A SOURCE RANGE MONITORING SYSTEM FOR LMFBR. Dayal, Y. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Nov 1972. Contract AT(04-3)-189. 80p. AT.

The results of an analytical study aimed at developing a source range monitoring (SRM) system for an LMFBR are presented. The system analyzed consisted basically of a detector with concentric cylindrical electrodes coated with ^{235}U, a cable with negligible pulse distortion properties, and a current preamplifier followed by conventional pulse-counting electronics. However, the design of the system components was arbitrary. The design parameters studied were those that affect the generation, transmission, and detection of signal and noise pulses. These included such detector parameters as gap size, gas type, gas pressure, thickness of uranium coating, density of coating, ^{235}U and ^{234}U content, and such electronic parameters as circuit time constants, gain, electronic noise sensitivity, and band width. The analytical methods developed show how to calculate the neutron count rate in the presence of interfering gamma, electronic noise, and alpha counts for any such arbitrarily designed system operating in an arbitrary neutron and gamma field. The analytical techniques were found experimentally to be accurate to within ±25%. These techniques were applied to predict the performance of a special, though not fully optimized, SRM system called the HTD-2 system. Complete results for the HTD-2 system are presented. (auth)

14420 (GEAP-13825-5) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE SYSTEMS FIFTH QUARTERLY REPORT, JANUARY–MARCH 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Apr 1973. Contract AT(04-3)-189. 38p. Dep. NTIS $4.00.

Information on the development of LMFBR in-core instrumentation and in-vessel surveillance systems is presented concerning high-temperature neutron detectors and cable assemblies; acoustic monitoring systems; reactor core exit instrumentation; failed fuel detection and location systems; on-line reactivity computer system; and plant protection system. (DCC)

14421 (HEDL-TME-72-92) FAST FLUX TEST FACILITY: DESIGN SAFETY ASSESSMENT. (Hanford Engineering Development Lab., Richland, Wash.). Jul 1972. Contract AT(45-1)-2170. 274p. AT $7.60.

Information provided in the FFTF Preliminary Safety Analysis Report is presented to show the bases for concluding that the plant is safe and can operate without undue risk to the health and safety of the public. The system design including the reactor, heat transport systems, inert gas system, instrumentation and controls, electric system, irradiation test facilities, fuel handling, plant protection system, structures, and the containment system are described. Initiating mechanisms, over-power accident analysis, flow coastdown accident analysis, mechanical consequences of a hypothetical accident, postaccident heat removal, and radiological consequences of hypothetical accidents are discussed. (FS)

14422 (LMEC-73-1) LIQUID METAL ENGINEERING CENTER (LMEC) ANNUAL TECHNICAL PROGRESS REPORT: JANUARY– DECEMBER 1972. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). 28 Feb 1973. Contract AT(04-3)-700. 469p. AT $10.60.

Information on the development of LMFBR components and systems is presented under the following topics: testing of the modular steam generator; initial operation of the FFTF pump shaft seal test assembly; testing of hot leg isolation valve and freeze stem gate valves; monitoring of freeze seal performance; testing of FFTF control rod drive bellows seal; sodium compatibility testing of reactor materials and thermal insulation; creep ratchetting tests for reactor materials; development and testing of reactor instrumentation; and testing of sodium fire suppression systems. (DCC)

14423 (ORNL-TM-3773) COMPUTER PROGRAM FOR CALCULATING TEMPERATURES ATTAINED BY LMFBR FUELS FROM DECAY HEAT EMISSION. Cox, R. L. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 67p. AT $5.50.

In the handling of spent LMFBR nuclear fuel assemblies, which will produce large quantities of heat by radioactive decay of fission products, it will be necessary to know the temperatures that may be expected in the various reprocessing steps in order to properly design the equipment and provide for auxiliary cooling, if required. A computer program, HEX, has been developed as a means of calculating, conservatively, the steady-state temperature distributions in hexagonal LMFBR fuel assemblies. In this program, it is assumed that heat is transferred within the array via thermal radiation interchange between rods. As a necessary first step, black-body view factors are derived for parallel cylinders on an equilateral triangular pitch. These view factors are then used in the HEX program to calculate the temperatures in any desired size of hexagonal array as a function of the emissivities of the surfaces, the pitch-to-diameter ratios of the rods, and the heat generation rates. The temperatures are calculated by the net radiation method in which one equation is used for each surface involved; proper account is taken of the possible energy interchanges between the various surfaces. The resulting temperature values may then be used appropriately in the design of reprocessing facilities and equipment. Sample calculations are presented as an aid to the prospective user of HEX. (auth)

14424 (ORNL-TM-4254) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR APRIL 1973. 189a No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 59p. AT $4.75.

The Westinghouse demonstration plant radial shield experiment was continued during April 1973. Hydrogen counter measurements are reported for several of the Westinghouse configurations, including the radial blanket and the full shield configurations. Measurements are also presented on the neutrons transmitted through Inconel thicknesses of 2½ and 5 in. These Inconel slabs were placed adjacent to the 10-in. radial blanket, and hydrogen counter, NE-213, and Bonner ball measurements were taken beyond the Inconel slabs to determine the transmitted neutron spectrum and fluence. The gamma-ray spectrum transmitted by the 5-in. Inconel slab was also determined. The neutron attenuation of a 5-in.-thick stainless steel slab placed beyond the Inconel was also determined using the Bonner ball detectors. (auth)

14425 (ORNL-TM-4255) CALCULATION OF MULTIPLICATION FACTOR VS TEMPERATURE FOR A MSBR LATTICE IN THE HTLTR AND COMPARISON WITH EXPERIMENT. Ragan, G. L. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

Multiplication factors, k_∞ have been calculated for comparison with experiments in the HTLTR for a lattice that simulates the neutronic characteristics of the Molten Salt Breeder Reactor (MSBR). The calculational tools used in MSBR design work were used, and no serious disagreement with the experiment was revealed. Calculated k_∞ was about 1% higher than the experimental values at all temperatures in the 20°C to 1000°C range covered. The calculated temperature defect was about 4% higher than the experimental value. Several minor calculational problems were revealed in the study; some were dealt with and others were pointed out for further action. (auth)

14426 (RDT-E-6-24-T(5-73)) INTERIM DECAY STORAGE FOR SODIUM-COOLED REACTORS. (Division of Reactor Devel-

opment and Technology (AEC), Washington, D. C.). Apr 1973. 23p. RSO.

The requirements for design, fabrication, packaging, shipment, and installing of an Interim Decay Storage (IDS) facility that will provide a temporary storage location for core components and test assemblies for a sodium-cooled reactor are presented. An IDS will provide a temperature-controlled, liquid sodium environment for new core components enroute to the reactor and irradiated core components and test assemblies that have been removed from the reactor. (auth)

14427 (WARD-5797) STRUCTURAL MATERIALS ASPECTS OF LMFBR CORE RESTRAINT SYSTEM DESIGN. Pennell, W. E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb. 1972. Contract AT(45-1)-2171. 50p. (CONF-720420-10). Dep. NTIS $4.50.

From conference on reactor materials performance; Richland, Washington, USA (24 Apr 1972).

Irradiation swelling and creep have a dominating influence on LMFBR core restraint system design. Careful attention must be given to the accommodation of these effects if core goal performance is to be achieved. Low swelling structural alloys offer the promise of a materials solution to the core restraint system design problem, but schedule requirements for performance verification testing appears to preclude their use in early LMFBR cores. Progress has been made in the development of design equations for swelling and creep prediction in austenitic stainless steels. Using these equations designers are able to define LMFBR core restraint concepts with acceptable burnup potential. Wide confidence limit bands and uncertain swelling-creep superposition laws must be accommodated in the design of the system. Improved designs would be possible if these uncertainties could be reduced. Swelling-creep superposition tests have received little attention from the experimenter, but it appears that advances may be possible in this area using available irradiated fuel pin cladding. (auth)

14428 (WARD-5892) KEYS TO OPEN THE DOOR TO INDUSTRIAL SUCCESS OF THE LMFBR. Taylor, J. J. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). 1972. 24p. (CONF-720817-3). Dep. NTIS $3.25.

From conference on nuclear power for tomorrow; Atlantic City, New Jersey, USA (22 Aug 1972).

The key requirements for industrial success of the LMFBR are discussed. These include definition of adequate standards and design criteria, licensability and environmental compatibility, industrial design competence and manufacturing capability, and economic attractiveness. (JWR)

14429 (WARD-5918) MIXING MODEL FOR WIRE WRAP FUEL ASSEMBLIES. Novendstern, E. H. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). 1972. Contract AT(45-1)-2171. 16p. (CONF-721109-25). Dep. NTIS $3.00.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

A mixing model embodied in a digital computer code, COTEC, and developed to determine temperature distribution in a wire-wrapped fuel assembly cooled by flowing sodium is described. Four phenomena which affect heat and mass transfer between subchannels are included in the model. These are: pumping, sweeping, turbulent mixing, and thermal conduction. With the calculational procedure described and using the CDC-7600, fuel assembly coolant temperatures in the 217-pin FFTF fuel assembly can be calculated in 30 sec. Predicted values have been checked against 19-pin sodium heat transfer data obtained in the FFM loop. Reasonable agreement was obtained using two different models to predict swirl in the outer edge subchannels. However, these swirl flow models give dramatically different results when they are applied to the FFTF 217-pin bundle. (LCL)

14430 (WARD-CR-3045-1) CORE RESTRAINT DEVELOPMENT. Quarterly Progress Report for Period Ending February 28, 1973. French, J. W. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). May 1973. Contract AT(11-1)-3045. 39p. AT $4.00. TIC.

The core restraint test rig mechanical assembly and alignment have been completed. The control panel has been assembled, and associated controls and instrumentation installed. All wiring is complete except for the instrumentation conduits. Analysis and design of compliant load pads has been completed. The majority of the required optical equipment has been purchased and placed in service in aligning the structure and the radial clamp assemblies. (auth)

14431 COMPARISON OF MEASURED WITH PREDICTED BURNUPS IN EBR-II. Laskiewicz, R. A.; Golden, G. H (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 106-107(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14432 EFFECT OF UO_2 INSULATOR PELLETS ON THE AXIAL FISSION RATE DISTRIBUTION IN EXPERIMENTS IN EBR-II. Miller, L. B.; Jarka, R. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 107(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14433 RADIOACTIVE DECONTAMINATION STUDIES OF LMFBR COOLANT SYSTEMS. Weaver, S.; Berkey, E. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 109(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14434 EFFECT OF FUEL DENSITY ON FUEL-CLADDING MECHANICAL INTERACTION IN LMFBR FUEL RODS. Hilbert, R. F. (General Electric Corp., San Jose, CA); Murata, R. E.; Stephens, J. D. Trans. Amer. Nucl. Soc.; 16: 120-121(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14435 CLADDING STRAIN CONSIDERATIONS IN LMFBR FUEL RODS. Kangilaski, M. (General Electric Corp., San Jose, CA); Stephen, J. D.; Hilbert, R. F. Trans. Amer Nucl. Soc.; 16: 121-122(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14436 SYSTEMATIC OPTIMIZATION OF LMFBR CORE COMPOSITION TO MINIMIZE VOID REACTIVITY. Tzanos, C. P. (Lowell Technical Inst., MA). Trans. Amer. Nucl. Soc.; 16: 142-143(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14437 DESIGN CONSIDERATIONS UNIQUE TO LMFBR RADIAL BLANKET ASSEMBLIES. Engel, F. C.; Markley, R. A. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 215(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14438 FRICTION FACTOR FOR GAS FLOW FROM DEFECTED FUEL RODS. Murata, R. E.; Hittle, G. E.; Gregoire, K. E.; Craig, C. N. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 216-217(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14439 EXPERIMENTAL EVALUATION OF FISSION-GAS RELEASE IN LMFBR FUEL SUBASSEMBLIES UNDER SUBSONIC AND NEAR-SUBSONIC CONDITIONS. Wilson, R. E.; van Erp, J. B.; Chawla, T. C. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 217-218(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14440 THERMAL MIXING IN THE EBR-II OUTLET PLENUM. Gopalakrishnan, A. (Argonne National Lab., IL); McGinnis, F. D. Trans. Amer. Nucl. Soc.; 16: 219-221(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14441 CONSIDERATIONS OF THERMAL-HYDRAULIC CHANNEL ARRANGEMENT IN A ROD BUNDLE. Sha, W. T.; Schmitt, R. C.; Huebotter, P. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 221-222(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14442 ON-LINE REACTIVITY COMPUTER FOR LMFBR APPLICATION. Glover, D.; Lu, Y. S.; Pflasterer, G. R. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 234-235(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14443 ANALYTICAL STUDY OF A SOURCE RANGE MONITORING SYSTEM FOR LMFBR. Dayal, Y. (General Electric Co., Sunnyvale, CA); Wimpee, L. C.; Swartz, P. Trans. Amer. Nucl. Soc.; 16: 236-237(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14444 PARFAIT BLANKET CONCEPT FOR FAST BREEDER REACTORS. Ducat, G.; Driscoll, M. J.; Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 16: 241(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14445 NUCLEAR ANALYSIS OF GAS CORE REACTOR CONFIGURATIONS FOR MHD POWER GENERATION. Kirby, K. D.; Clement, J. D.; Williams, J. R. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 16: 243-244(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14446 POST-SHUTDOWN FISSION PRODUCT ENERGY RELEASE FOR ^{239}Pu FAST REACTORS. Sporrer, R.; Christenson, J. M. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 16: 245-246(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14447 11:1 SCALE MODEL ROD BUNDLE AIR FLOW TESTS: BARE ROD SUBCHANNEL FLOW RATE STUDIES. Pechersky, M. J. (Westinghouse Electric Corp., Madison, PA); Roidt, R. M.; Markley, R. A.; Vegter, B. J. Trans. Amer. Nucl. Soc.; 16: 246-247(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14448 FUEL-ROD GRID-SPACER WEAR AND FRETTING IN GAS COOLED FAST BREEDER REACTOR FUEL ELEMENTS. Flynn, P. W.; Weinberg, A. F.; Ream, J. T. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 248-249(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14449 CORRELATION OF THE EBR-II PRIMARY COOLANT PUMP PERFORMANCE DATA. Gopalakrishnan, A.; Gillette, J. L. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 254-255(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14450 OPTIMIZATION OF SUBASSEMBLY COOLANT FLOW RATES TO MINIMIZE THERMAL BOWING EFFECTS. Gopalakrishnan, A.; Gillette, J. L.; Mohr, D.; Meneghetti, D. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 255-256(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14451 CORRELATION OF MECHANICAL NOISE WITH NEUTRON NOISE IN EBR-II. Price, C. C. (Argonne National Lab., Idaho Falls, ID); Karvinen, J. R.; Noggle, L. W. Trans. Amer. Nucl. Soc.; 16: 256-257(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14452 COMPARISON OF RADIOACTIVE GAS RELEASE FROM A MIXED OXIDE AND A METAL-DRIVER FUEL ELEMENT TO THE COVER GAS OF EBR-II. Koenig, J. F.; Brunson, G. S. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 16: 257-258(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14453 NUCLEAR DESIGN CONSIDERATIONS FOR THE LMFBR PROGRAM. Riley, D. R.; Buhl, A. R. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 273(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14454 REACTOR PHYSICS PROBLEMS FOR LMFBR. Greebler, P.; Bailey, H. S. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 274-275(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14455 PHYSICS NEEDS FOR THE DESIGN OF THE COMMERCIAL LMFBRs. Dickson, P. W.; Dyos, M. W. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 275(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14456 PHYSICS DESIGN PROBLEMS RELEVANT TO THE GAS-COOLED FAST BREEDER DEMONSTRATION PLANT. Cerbone, R. J.; Moore, R. A. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 276-277(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14457 LMFBR CORE DESIGN, REACTOR PHYSICS, AND SAFETY. Okrent, D. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 16: 277(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14458 TESTS OF APPROXIMATE METHODS OF CALCULATING SODIUM VOIDING EFFECTS IN LARGE FAST REACTORS. Palmer, R. G. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 16: 279-280(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14459 SODIUM VOID COEFFICIENTS IN FAST REACTORS. Takeda, S.; Takeda, R. (Hitachi, Ltd., Kawasaki, Japan). Trans. Amer. Nucl. Soc.; 16: 280-281(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14460 STATUS OF SUBCRITICAL REACTIVITY DETERMINATION FOR LMFBRs. Buhl, A. R. (Oak Ridge National Lab., TN); Ackermann, N. J. Jr.; Robinson, J. C. Trans. Amer. Nucl. Soc.; 16: 289-290(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14461 EBR-II NOISE ANALYSIS STUDY UTILIZING INHERENT FLUCTUATIONS. Ebert, D. D. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 298-299(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14462 EBR-II LOADING EFFECTS ON DROP-ROD REACTIVITY PROFILES. Franklin, F. C. (Argonne National Lab., IL); Stenstrom, D. G.; Meneghetti, D.; Hyndman, R. W. Trans. Amer. Nucl. Soc.; 16: 303–Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14463 AXIAL EFFECTS OF EXPERIMENTAL SUBASSEMBLIES IN RADIAL REGIONS OF EBR-II. Laskiewicz, R. A.; Meneghetti, D. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 309-310(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14464 DIFFUSION AND TRANSPORT THEORY CALCULATIONS FOR THE DEEP-PENETRATION NEUTRON SPECTRA IN EBR-II. Sehgal, B. R.; Rempert, R. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 339-340(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14465 EXPERIMENTAL INVESTIGATIONS ON THE HEAT TRANSFER AND FLUID DYNAMICS OF FAST BREEDER CORE ELEMENTS. Hoffman, H. (Kernforschungszentrum, Karlsruhe, Ger.); Weinberg, D.; Markfort, D.; Voj, P. (1973). vp. (In German).
From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).
The present state of knowledge with respect to fast breeder development as far as pressure losses, interchannel mixing effects, and heat transfer characteristics are concerned, is summarized. Relative to the requirements for the evaluation of heat transfer and fluid dynamic core parameters for SNR 300, special emphasis is placed on the accuracy of the experimental results, the defects of functional relations and the tolerances of core structure. The result of the present discussion is: the accuracy of representative results is sufficient for core design and layout and special experiments have to be performed for confirmation, as well as to fulfill requirements for detail information. (GE)

Research, Test, and Experimental Reactors

Refer also to abstracts 12823, 12969, 13411, 14352, 14401, 14418, 14422, 14579, 14600, and 14671.

14466 (CONF-721112-11) DESIGN AND ANALYSIS EXPERIENCE WITH A LIQUID METAL HEAT EXCHANGER FOR FFTF SERVICE. Gangadharan, A. C. (Foster Wheeler Corp., New York). 1972. 26p. Dep. NTIS $3.50.
From American Society of Mechanical Engineers winter meeting; New York, New York, USA (26 Nov 1972).

Experience with high temperature design of an intermediate heat exchanger for FFTF service is described. The discussion emphasizes the results of a detailed inelastic analysis of one IHX component, using the MARC II program. The basic approach taken in the selection and use of the general purpose finite element program for inelastic analysis is also described. The reduction and interpretation of finite element solution and the associated cost are discussed. The need for a simplified approach to the inelastic analysis is emphasized. (auth)

14467 (CONF-721112-12) DESIGN AND ANALYSIS ASPECTS OF THE FFTF INTERMEDIATE HEAT EXCHANGER FOR HIGH TEMPERATURE SODIUM SERVICE. Pai, D. H. (Foster Wheeler Corp., New York). [nd]. 4p. Dep. NTIS $3.00.

From American Society of Mechanical Engineers winter meeting; New York, New York, USA (26 Nov 1972).

The heat exchangers for the FFTF reactor are briefly described. Some of the unique design-analysis and fabrication features of the unit are highlighted. (JWR)

14468 (CONF-721202-19) FAST BREEDER REACTOR PLANT PROTECTION SYSTEM INSTRUMENTATION. Werner, J. E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). [nd]. Contract AT(45-1)-2171. 40p. Dep. NTIS $4.00.

From nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

The Plant Protection System (PPS) of the Fast Flux Test Facility (FFTF) is designed to meet the requirements of RDT Standard, RDT C16-1T, Supplementary Criteria for Reactor Plant Protection Systems. The ways in which temperature, flow, level, pressure, and flux measurement instrumentation have been combined with solid state logic equipment and integrated into an overall protection system which meets the criteria of the RDT Standard are described. Functional and performance requirements placed on this instrumentation and logic equipment are typical of requirements which will be placed on these components by future breeder reactors. The FFTF PPS, in general, uses commercially available measurement instrumentation. The logic equipment is well within the state of the art but has been specifically designed for use in FFTF. (auth)

14469 (COO-2275-1) UNIVERSITY REACTOR SHARING PROGRAM. Progress Report, 1 September 1972–31 May 1973. Carey, W. E.; Hajek, B. K. (Ohio State Univ., Columbus). [nd]. Contract AT[11-1]-2275. 7p. Dep. NTIS $3.00.

Eight schools have utilized The Ohio State University Research Reactor (OSURR) under the USAEC Reactor Sharing Program. A total of 82 students, supervised by 10 faculty members from user institutions, have participated in experiments involving neutron activation analysis, isotope production, and reactor engineering and physics laboratories. (auth)

14470 (EIR-228) MEASUREMENT ON A SINGLE FUEL ELEMENT IN PROTEUS. Rueegger, B. (Eidgenoessisches Institut Fuel Reaktorforschung, Wuerenlingen (Switzerland)). Dec 1972. 52p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

The details and the results of the last measurements made on a heavy-water moderated lattice in PROTEUS before its transformation into a mixed fast-thermal reactor are reported. Four series of measurements were made with the following fuel configurations at the center of the reactor: a cluster identical to that of the rest of the lattice, a cluster formed of the same fuel as that in the preceding but arranged in a circular geometry, a central cell 70 cm in length containing 37 rods of UO_2 with 3% ^{235}U 10 mm in the diameter arranged in a circular geometry, and a geometry identical to the preceding but containing a mixture of UO_2/PuO_2 (0.8% ^{239}Pu and 0.43% ^{235}U) in place of the 3% ^{235}U. The conversion ratio, the ratio of the ^{239}Pu fission rate to the ^{235}U fission rate, the reaction rate of the copper and gold, and the reactivity of the different elements studied were measured. (JSR)

14471 (EUR-4820(Vol.3)(Pt.F), pp 169-187) ENGINEERING PROBLEMS WITH LOOP PRESSURE TUBES FOR THE SODIUM COOLED FAST HIGH-FLUX REACTOR FR3. Fiege, A.; Peterson, H. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Difficult engineering problems are encountered in the loop design for the sodium-cooled fast high-flux reactor FR3 due to the fact that considerable irradiation damage (embrittlement, swelling of material) must be anticipated in the loop tubes as a result of the high fast neutron dose. A quantitative determination is given of the inherent stresses due to differential swelling and thermal strains superimposing the stresses produced mechanically by internal pressure, as well as the deflections and bending stresses caused by restoring forces in the pressure tubes. Referring to the presently known but not yet sufficiently supported swelling formulas, for the desired service life of 210 days the wall-thickness of pressure tubes of the central helium loop in the core region must be reduced to about 5 to 5.5 mm, which calls for restriction of the permitted coolant pressure to about 100 atm. In the case of peripheral sodium loops the deflections of loop tubes can be managed only by a one-wall design of pressure tubes and by largely suppressing swelling of the asutenitic loop tube through "keeping cold." (8 references) (auth)

14472 (EUR-4820(Vol. 6)(Pt. L), pp 605-614) FRACTURE BEHAVIOR INVESTIGATIONS OF 10 Cr-Mo-Ni-Nb 910 STEEL PIPES. Zeibig, H.; Fortmann, E. (Interatom, Bensberg, Ger.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Experimental investigations were made in order to test the fracture behavior of the primary coolant pipe system of the sodium cooled KNK test reactor. The experiments were conducted with through-wall flawed specimens of the original pipes used in the loop of the reactor. The theoretical investigations of the fracture mechanics predict, that even at room temperatures unstable fracturing can be excluded, so that it definitely can not occur at operating conditions. The critical crack sizes are so large, that system failures will manifest themselves by leaking prior to fracture. For the double pipe section used in the loop between valves and reactor vessel it can, therefore, be concluded that the outer pipe cannot be damaged by the loss of integrity of the inner pipe. It is safe to say that no sudden rupture can occur. Further investigations are planned in order to study the sub-critical crack growth behavior on more complex shapes. (auth)

14473 (HEDL-SA-297) X-RAY REAL-TIME IMAGING FOR NONDESTRUCTIVE TESTING OF FAST FLUX TEST FACILITY FUEL PINS. Jackson, C. N. Jr.; Gray, W. H. (Hanford Engineering Development Lab., Richland, Wash.). Sep 1971. Contract AT(45-1)-2170. 19p. (CONF-720225-2). Dep. NTIS $3.00.

From society for photo-optical instrumentation engineers conference; Anaheim, California, USA (14 Feb 1972).

The development of an x-ray imaging system for real-time inspection of FFTF fuel pins is described. The system consists of a shielded facility, an x-ray generating unit, and an x-ray-sensitive Vidicon camera closed circuit video system. Both dynamic and static inspection of fuel pin internal components can be made. This system has the advantages of providing: a historical record of selected areas; 360° volumetric inspection; 24X magnification; highly efficient radiographic techniques; and real-time evaluation. The inspection unit was designed for rapid, thorough, and economic examination of the FFTF fuel pin and will perform materials inspection for integrity and needed dimensional verification. (LCL)

14474 (HEDL-SA-546) MATERIALS CONSIDERATIONS IN THE FAST FLUX TEST REACTOR. Sheely, W. F. (Hanford Engineering Development Lab., Richland, Wash.). Contract AT(45-1)-2170. 36p. (CONF-730333-1). Dep. NTIS $4.00.

From meeting of the American Society for Metals; LaGrange, Illinois, USA (19 Mar 1973).

Some of the materials design considerations that have gone into the FFTF development are described with particular emphasis on aspects that will influence LMFBR design. Some examples of materials considerations that are unique to fast reactors are discussed. (JWR)

14475 (HEDL-TME-73-26) FFTF FISSION GAS DELAY BED: ENGINEERING SCALE TEST REPORT. Kabele, T. J.; McElroy, J. L.; Badgett, E. O.; Bohringer, A. P. (Hanford Engineering Development Lab., Richland, Wash.). May 1973. Contract AT(45-1)-2170. 25p.

The dynamic adsorption coefficients of ^{133}Xe, ^{85}Kr, and ^{41}Ar on activated charcoal from a pure argon carrier gas stream were measured at temperatures from +25 to −160°C and at pressures from zero to +30 psig. These measurements will provide the design basis for the charcoal beds in the FFTF Radioactive Argon Processing System. (auth)

14476 (HEDL-TME-73-40) ANALYSIS OF THE MEASURED GAMMA DOSE RATE DISTRIBUTION IN THE FTR/EMC. Boulette, E. T.; Marr, D. R.; Bunch, W. L. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1973. Contract AT (45-1)-2170. 56p. AT $5.45.

One-dimensional gamma transport theory analyses are presented and compared with gamma dose rate measurements at nearly 400 different locations in the Fast Test Reactor/Engineering Mockup Critical (FTR/EMC) assembly. The results are presented on an

absolute basis and the impact of the analytical–experimental correlation on the FTR design is discussed. (auth)

14477 (JUL-928-RG) INVESTIGATIONS OF DRIVER-ROD CONFIGURATIONS OF THE CRITICAL FACILITY ITR. Bloser, M.; Kirch, N.; Krings, F. J.; Paul, N.; Naseband, A. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Feb 1973. 121p. (In German). Dep. NTIS (U. S. Sales Only) $8.25.

Zero-energy experiments have been performed to design modern power reactors and to check calculation methods and nuclear data. From the reactor physics point of view, ITR is characterized by the compact, very heterogeneous construction, and by novel structure materials. The critical facility helped build up very different configurations of fuel elements and reflector; thus it was possible to improve the results of calculation methods and to assess the suitability of data sets. The facility and the measuring techniques are explained. The influences on critical mass as well as numerical and experimental reactivity values of components are discussed. The results of both measurements and calculations of reaction rates are compared considering spatial-dependence of reactor spectrum and power flattening. (auth)

14478 (LFEN-145-a) EXPERIMENTAL STUDY OF DYNAMIC BEHAVIOR OF THE PORTUGUESE RESEARCH REACTOR (RPI). Costa Oliveira, J. M.; Da Veiga, C. A. M.; Trigueiros, D. F. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 44p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $4.25.

The transfer function of the Portuguese Research Reactor (PRI) was measured by the method of reactivity modulation. The measurement technique used is the principle of numerical treatment of the experimental data. The results obtained at zero power in the band between 5×10^{-3} Hz and 65 Hz were compared with the predictions of the point kinetic theory and the influence of the space harmonics in the dynamic behavior of the reactor was established. The values of the transfer function, deduced for the time of generation of the instantaneous neutrons, is $\Lambda = (56 \pm 2) \times 10^{-6}$ sec, considering an effective fraction of the delayed neutrons $\beta_e = (760 \pm 23) \times 10^{-5}$. The study made at high power (up to 1 MW) made it possible to show the performance effects caused by the modulation of the temperature in the core. (tr-auth)

14479 (ORNL-4875) FUEL-CLADDING MECHANICAL INTERACTION AND GAS PRESSURE BUILDUP IN A SHORTENED FTR-TYPE FUEL PIN. Fitts, R. B.; Fleischer, B.; Senn, R. L. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 102p. Dep. NTIS $5.45.

The design and operation of an experiment (MINT-1) to evaluate fuel-cladding interaction and gas pressure buildup in a prototype FTR fuel pin is described. The capsule was instrumented to measure fuel and cladding length, internal gas pressure in the fuel pin, and cladding temperature. The test fuel pin was a shortened FTR-type $(U,Pu)O_2$ pin with type 316 stainless steel cladding. The capsule was designed to operate at controlled, continuously variable fuel pin powers from 0 to 19.5 kW/ft with corresponding cladding midwall temperatures up to 700°C. The data on fuel pin performance indicated, as expected, that mechanical interaction will not be a problem in the FTR fuel pin at the low burnup (1.7% FIMA) achieved in this test. Cladding thermal expansion was uniform and predictable on the basis of existing data. Fuel thermal excansion was less uniform but always fell between the expansion calculated on the basis of fuel pellet surface temperature and that calculated on the basis of the temperature at the inner edge of the end dish on the pellet with an expansion coefficient of 10×10^{-6}/°C. During operation at constant power the fuel first contracted because of creep or sintering and then expanded with burnup accumulation. The release of fission gases from the fuel depended upon power level and history but was not affected by power cycling. (auth)

14480 (PWAC-459) LCRE REACTOR PRESSURE VESSEL REPORT. Vitali, V. J.; Neumeister, R. L. (Pratt and Whitney Aircraft, Middletown, Conn.). 28 May 1965. Contract AT(30-1)-2789. 48p. Dep. NTIS $4.50.

Declassified 4 Jun 1973.

The vessel, filled with lithium and internally pressurized to produce an effective stress of 1400 psi in the cylinder, completed 10,000 hours of test at 2000°F without leakage. The initial test startup procedure was interrupted when an Inconel tube on the jacket system failed. The failure occurred when the specimen temperature was 2000°F but before application of the test pressure. It was later determined that the failure was due to a tube being restrained and not being permitted axial thermal expansion. The test was cooled to room temperature, the failed tube repaired, the restraint on the tube eliminated and the test restarted. The test was again interrupted at 5841 test hours when it was determined that enough of the electrical heaters, used to heat the specimen, had failed to warrant a complete change of heaters. All the heaters on the specimen heating system were replaced and the test resumed to completion without further incident. The highest effective stress that could be imposed on the vessel was 1400 psi. An internal pressure in excess of that required to produce an effective stress of 1400 psi in the cylinder would have created stresses in certain areas of the heads above the present CANEL effective design stress of 1500 psi. Design stress at CANEL is defined as one-half stress rupture or the stress that will cause 1% creep—whichever is less. Post-test measurements indicated a maximum 0.284 percent diametral creep in the cylinder. Creep growth was not measured in the heads. Visually, the specimen was clean and free from discoloration. There was no evidence that lithium leaked from the vessel. There was no evidence of liquid metal corrosion or appreciable interstitial contamination in representative vessel base metal or weld areas examined. However, appreciable nitrogen contamination was found in the outer tantalum foil wrap. Several ID fluorescent penetrant indications, found adjacent to the upper head to cylinder weld, extended to a maximum depth of 8 mils. The defects are believed to be surface ruptures resulting from tool chatter during machining. (auth)

14481 (RT/ING-(72)20) SIGNIFICANT ASPECTS CONCERNING RC-1 TRIGA REACTOR OPERATIONS. Di Palo, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 Oct 1972. 52p. (CONF-720993-1). Dep. NTIS (U. S. Sales Only) $4.75.

From 2nd European conference of TRIGA reactor users; Pavia, Italy (13 Sep 1972).

The various nuclear configurations with which the reactor operated after completion of the works directed at obtaining a power increase from 0.1 to 1 MW are described, and the reactor utilizations are suggested. Furthermore, through experimental measurements of the neutron flux in significant positions, the volumetric integral of the flux in the core is solved by defining, with conservative conditions of nuclear configuration and of reactor operation, the peak factor referred to the most stressed element of the TRIGA core. (auth)

14482 (SC-RR-720724) UPGRADING THE STEADY-STATE POWER OF THE ANNULAR CORE PULSE REACTOR. Estes, B. F.; Morris, F. M. (Sandia Labs., Livermore, Calif.). Dec 1972. 36p. Dep. NTIS $4.00.

An experiment conducted to evaluate reactor behavior and determine core thermal characteristics of the Annular Core Pulse Reactor at steady state power levels up to 600 kW is described. (JWR)

14483 (WARD-2171-30) FAST FLUX TEST FACILITY QUARTERLY PROGRESS REPORT FOR THE PERIOD JUNE–JULY–AUGUST 1972. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). 1972. Contract AT(45-1)-2171. 114p. AT $7.75.

Research and development activities for the FFTF Reactor are presented under the following headings: reactor system design and engineering; reactor analysis; reactor core system; fuel assemblies; reactor enclosure system; core support structure; control rod system; startup system; closed loop in-reactor assembly; in-vessel handling machine; reactor plant system engineering; heat transport system components and engineering; plant control and data acquisition; component test and materials analysis; and project administration. (DCC)

14484 (WARD-2171-32) REFERENCE FTR FUEL MANAGEMENT SCHEME: SCATTER REFUELING, FIXED METHODS, AND PERFORMANCE CHARACTERISTICS. Calamai, G. J. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div). Mar 1973. Contract AT(45-1)-2171. 138p. AT $5.45.

The FTR fuel management using the reference scatter refueling scheme has been specified. Based on a detailed study of the approach to equilibrium cycle conditions, the preferred fixed shimming techniques are also recommended. The performance characteristics of the core for the first few operating cycles are revised. Detailed core performance results including average discharge burnup, neutron flux distributions and power density distributions are presented for the first six operating cycles in FTR. (24 references) (auth)

14485 HISTORY OF URANIUM FABRICATION AND DEVELOPMENT OF FUEL ELEMENTS FOR CP-3. Simmons, J. M. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 91-92(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14486 HISTORY AND DEVELOPMENT OF FUEL ELEMENTS FOR THE CLINTON, HANFORD, AND BROOKHAVEN REACTORS. Gurinsky, D. H. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 16: 92(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14487 HISTORY AND DEVELOPMENT OF FUEL ELEMENTS FOR CLEMENTINE. Turovlin, B. (Army Engineering Power Group, Ft. Belvoir, VA). Trans. Amer. Nucl. Soc.; 16: 92-93 Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14488 HISTORY OF THE DEVELOPMENT OF FUEL ELEMENTS OF EBR-1. Foote, F. G. Trans. Amer. Nucl. Soc.; 16: 93(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14489 FUEL-FAILURE MONITORING MODEL FOR THE FFTF. Holt, F. E.; Cash, R. J. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 107-108(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14490 ACTIVATED CORROSION PRODUCT RADIATION LEVELS IN FFTF. Kabele, T. J.; Brehm, W. F.; Marr, D. R. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 108-109(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14491 ANALYTICAL INTERPRETATION OF THE FFTF PLUGGING TEMPERATURE INDICATOR. Yunker, W. H.; McGown, J. J.; Caplinger, W. H. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 114-115(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14492 SEFOR COLD-TYPE EXPERIENCE. Plummer, M. C.; Gadeken, A. D. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 115-116(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14493 COOLANT CHEMISTRY CHARACTERIZATION OF THE ENGINEERING AND ADVANCED TEST REACTORS. Larrick, A. P. (Allied Chemical Corp., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 16: 117(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14494 COMPUTATIONAL TECHNIQUE FOR ASSESSING PROCEDURES TO LOCATE FAILED FUEL. McCormick, N. J. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 16: 140-141(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14495 CRITICALITY RESEARCH AT THE OAK RIDGE CRITICAL EXPERIMENTS FACILITY. Johnson, E. B. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 16: 153-154(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14496 CRITICALITY EXPERIMENTS FOR CRITICALITY SAFETY AT PACIFIC NORTHWEST LABORATORY. Clayton, E. D.; Bierman, S. R.; Lloyd, R. C. (Battelle-Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 154-157(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14497 MINIMIZATION OF THE DOUBLE-RELEASE PROBLEM IN THE FTR GAS TAG SYSTEM. Omberg, R. P.; Schenter, R. E. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 215-216(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14498 $UA1_x$ FUEL IN RESEARCH REACTORS. Cox, E. L.; Alger, D. M.; Julian, C. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 16: 259-260(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14499 CALCULATION OF ZPR-6-6A AND 6-7 WITH KARLSRUHE DATA AND METHODS. Oosterkamp, W. J. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 16: 261-262(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14500 STRUCTURAL MATERIAL DOPPLER EFFECTS IN THE FFTF ENGINEERING MOCKUP. Meyer, J. F. (Argonne National Lab., IL); Moore, R. A.; Daughtry, J. W.; Kier, P. H. Trans. Amer. Nucl. Soc.; 16: 262(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14501 COMPARISON OF CALCULATED AND MEASURED REACTION-RATE DISTRIBUTIONS AND FISSION INTEGRALS IN ZPR-6 ASSEMBLY 7. Robinson, W. R.; Bohn, E. M.; Stanford, G. S. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 263-265(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14502 ANALYSIS OF HIGH ^{240}Pu ZONED CRITICAL EXPERIMENTS IN SUPPORT OF LWR-GRADE Pu UTILIZATION IN FTR. Ramchandran, S.; Rathbun, R. W. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 265(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14503 ANALYSIS OF THE SNEAK ASSEMBLIES 9B AND 9A-O. Fehsenfeld, P.; Jourdan, G.; Pinter, M.; Raberain, A. M.; Scholtyssek, W. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 16: 265-266(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14504 MULTI-CELL HETEROGENEITY IN CRITICAL ASSEMBLIES. Barthold, W. P.; Calamai, G. J.; Heenan, T. F. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 266-267(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14505 ^{238}U DOPPLER REACTIVITY MAPPING IN THE FFTF ENGINEERING MOCKUP CRITICAL. Meyer, J. F. (Argonne National Lab., IL); Daughtry, J. W.; Swanson, C. D.; Moore, R. A. Trans. Amer. Nucl. Soc.; 16: 270-272 (Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14506 PHYSICS ASPECTS OF FTR DESIGN. Fox, P. F.; Ramchandran, S. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 273-274(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14507 PHYSICS-ORIENTED DESIGN CONSIDERATIONS OF EBR-II. Meneghetti, D.; Loewenstein, W. B. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 275-276(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14508 FINAL FUEL PIN ENRICHMENT AND CONTROL ROD LOADINGS FOR FAST TEST REACTOR. Ramchandran, S.; Calamai, G. J. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 278-279(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14509 APPLICATION OF THE RESULTS OF THE SEFOR DOPPLER EXPERIMENTS TO FTR. Harris, R. A. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 281(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14510 NEUTRON IMPORTANCE IN SPHERICAL PLUTONIUM METAL ASSEMBLIES. Mihalczo, J. T. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 16: 281-282(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14511 ARGONNE EXPERIENCE IN MEASUREMENT OF REACTIVITY OF SUBCRITICAL FAST REACTOR. Bennett, E. F. (Argonne National Lab., IL); Carpenter, S. G.; Cohn, C. E.; Shaftman, D. H. Trans. Amer. Nucl. Soc.; 16: 290-291(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14512 KINETICS MEASUREMENTS ON COUPLED CORES IN THE ZED-2 REACTOR. McDonnell, F. N.; Hinds, H. W.; Garvey, P. M.; Walker, D. H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 16: 293-294(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14513 DOPPLER REACTIVITY TRAVERSES BY INVERSE KINETICS. Cohn, C. E.; Meyer, J. F. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 295(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14514 REFLECTOR BURST EXPERIMENT WITH SPR II. Schmidt, T. R.; Reuscher, J. A. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 16: 296(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14515 SUBCRITICALITY DETERMINATION BY A NOVEL INVERSE KINETICS TECHNIQUE. Yang, C. Y.; Albrecht, R. W. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 16: 297-298(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14516 CROSS-SECTION SENSITIVITY STUDIES FOR ZPR-6 ASSEMBLY 7. Hummel, H. H.; Stacey, W. M. Jr. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 321-323(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14517 FFTF PIPE CHASE STREAMING EXPERIMENT: PHASE II. McGregor, B. J.; Muckenthaler, F. J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 337(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14518 ANALYSIS OF ZPPR/FTR-2 NEUTRON REACTION RATES USING ENDF/B-III DATA. Muir, D. W.; LaBauve, R. J.; Alcouffe, R. E. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 337-338(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14519 ANALYSIS OF TLD MEASUREMENTS IN THE FTR/EMC. Boulette, E. T.; Marr, D. R.; Bunch, W. L. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 338-339(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14520 DESIGN OF A HIGH-TEMPERATURE NEUTRON IRRADIATION CONTAINER. Fee, D. C.; Markowitz, S. S. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 109: No. 3, 445-448(1973).
The design and construction of a neutron irradiation container in which all samples receive the same total neutron dose and the temperature is controlled to ±0.5°C in the 25°C range is reported. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 14637.

14521 (AAEC/E-252) DESIGN OF IRRADIATION EXPERIMENTS FOR MATERIALS TESTING REACTORS. McAneny, R. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.
An approach to the design of in-pile assemblies and the fundamental problems facing designers of these assemblies are discussed. The irradiation rig program at the Australian Atomic Energy Commission is discussed, and some general purpose rigs used at Lucas Heights are described. (auth)

14522 (BLG-473) CALCULATION OF THE CRITICAL HEAT FLUX IN THE FUEL CAN OF THE MATERIAL TEST REACTOR BR2. Volume II. (Figures). de West-Meerbeeck, A. B. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1972. 34p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.
Charts and figures relating to the calculation of the critical heat flux in the fuel can of the BR2 reactor are compiled. (JSR)

14523 (CEA-N-1613) LIQUID HYDROGEN LOOP: EL_3 REACTOR-H_5 BEAM. Working Instructions for the Installation. Farnoux, B. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1973. 40p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.
The working instructions for the liquid hydrogen liquefier of the Saclay EL3 reactor are described. This apparatus is connected to a small cell near the reactor core which increases the cold neutron flux. The system can operate over long periods without supervision. A brief description of the installation is given together with the safety devices incorporated in the apparatus and the measures to be taken in the event of incidents. Trials carried out with a prototype as well as on the in-pile functioning of a preliminary installation are presented. (FR)

14524 ZIRCALOY-2 PRESSURE TUBE EXPERIENCE AT THE HANFORD N REACTOR. Carlson, P. A.; Russell, A.; Schmidt, J. P. (Douglas United Nuclear, Inc., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 98-99(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14525 TEKHNIKA OBLUCHENIYA MATERIALOV V REAKTORAKH SVYSOKIM NEITRONNYM POTOKOM. (Techniques for Irradiating Materials in Reactors With a High Neutron Flux). Tsykanov, V. A.; Samsonov, B. V. Moscow; Atomizdat (1973). 264p.
The principles of attaining large neutron fluxes in research reactors are set forth, along with a discussion of three types of research reactors: pool, tank, and canal. Characteristics of fuel materials, non-fissioning materials, the measurement and monitoring of neutron fluxes, the evaluation of energy release in fuels and in materials of construction, and methods of temperature control are examined in detail. Irradiation techniques for different types of materials are summarized. (138 references) (KSW)

14526 HIGH DUTY COMPACT MTR-CORES: THERMOHYDRAULIC AND NUCLEAR DESIGN AND ITS EXPERIMENTAL VERIFICATION. Bormann, H. J.; Katscher, W.; Muench, E. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).
From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).
A description is given of the design studies and especially of the measurements made. The examination of the design data was carried out during the start-up experiments. The agreement between the nuclear and the thermohydraulic design calculations with the experimental results permits the establishment of criteria which, at least for MTR-cores, allow a high efficiency with sufficient attention being paid to the required safety distances to avoid burnout and flow instability. (GE)

Propulsion and Package Reactors

Refer also to abstracts 14831-14833.

14527 (AI-AEC-13076(Vol.1)) SELECTED COMPUTER CODES AND LIBRARIES. Volume I. ZIP: A Timeshare Program for SNAP Reactor Parametric Studies. Rood, H. (Atomics International Div., Canoga Park, Calif. (USA)). 21 Jun 1973. Contract AT(04-3)-701. 62p. Dep. NTIS $5.25.
ZIP is a FORTRAN program written for the Honeywell 440 timeshare computer. It is a parametric survey code which applies specifically to SNAP-type nuclear reactors; i.e., compact U-ZrH-fueled, beryllium-reflected, NaK-cooled reactors. As input, the code requires information about the mission requirements (power level, operating lifetime, coolant outlet temperature, etc.) and sufficient dimensional information to describe the reactor (fuel length, cladding thickness, reflector thickness, etc.). Then, using simple equations fit to results obtained using more complex codes, ZIP determines all the significant nuclear and thermal performance characteristics of the reactor. Also included is a shield thickness calculation, and a calculation of the reactor and shield weights. (auth)

14528 (AI-AEC-13076(Vol.4)) SELECTED COMPUTER CODES AND LIBRARIES. Volume IV. A 28-Group Cross Section Library for SNAP Reactor Analysis. Otter, J. M. (Atomics International Div., Canoga Park, Calif. (USA)). 31 May 1973. Contract AT(04-3)-701. 133p. Dep. NTIS $8.75.
A library of 28-group neutron cross sections designed for SNAP reactor analyses is described. Sources of microscopic cross section data, flux weighting spectra, and data processing methods are given. A listing of the library in the ANISN code format is included. (auth)

14529 (AI-AEC-13076(Vol.5)) SELECTED COMPUTER CODES AND LIBRARIES. Volume V. TEMPRO: A Heat Transfer-Lifetime Code for SNAP Reactor Analysis. Felten, L. D.; Moody, E. (Atomics International Div., Canoga Park, Calif. (USA)). 24 May 1973. Contract AT(04-3)-701. 61p. Dep. NTIS $5.25.

The TEMPRO computer program does heat transfer and reactivity calculations as a function of time for SNAP-type reactors. It determines hydrogen loss rates and the associated reactivity loss. Fuel swelling, uranium burnup, and fission product buildup are considered. (auth)

14530 (AI-AEC-13081) RADIATION SHIELDING FOR ZIRCONIUM HYDRIDE REACTOR SYSTEMS. Keshishian, V.; Facha, J. V.; Thomson, R. J.; Welch, F. H. (Atomics International Div., Canoga Park, Calif. (USA)). 26 Jun 1973. Contract AT(04-3)-701. 192p. Dep. NTIS $11.75.

A summary is given of the radiation shielding for zirconium hydride (ZrH) reactors. Shield nuclear calculational methods are discussed. The shield variations for unmanned and manned space systems, in addition to terrestrial systems, are presented. Both neutron and gamma-ray shield fabrication methods for ZrH reactor shields are discussed in detail. The nuclear and mechanical aspects of the 5-kW(e) Reactor Thermoelectric System shield are presented in detail. 35 references. (auth)

14531 (AI-AEC-13085) BURNABLE POISON DEPOSITION ON ZIRCONIUM HYDRIDE FUEL: PROCESS DEVELOPMENT AND EVALUATION. Van Houten, R. (Atomics International Div., Canoga Park, Calif. (USA)). 22 Jun 1973. Contract AT-(04-3)-701. 62p. Dep. NTIS $5.25.

The development and evaluation of a process for depositing thin rare earth oxide burnable poison films on fuel rods are reviewed. The burnable poison films are formed by controlled-rate, electron-beam-heated, high-vacuum evaporation of the oxides from water-cooled crucibles. Coating uniformity (mg poison/cm^2) and reproducibility are good (to ±5%), and rapid, accurate nondestructive x-ray fluorescence analytical procedures permit up to 100% inspection (all surface areas of all coated fuel rods). Poison placement screening criteria, recommended coating and measuring equipment performance, and swelling and aging test results are given. All test results for Gd_2O_3, Er_2O_3, and Y_2O_3 coatings are promising. Vapor-deposited coatings containing Eu_2O_3 and/or Sm_2O_3 are not recommended, because of rapid transfer of Eu and Sm to the SCB hydrogen barrier; but preliminary tests on the incorporation of up to 9 wt % Eu in an SCB-type sleeve showed good Eu retention through 1510 hr at 1430°F, and good SCB stability. Tests extended to 18,584 hr at 1300°F, to 10,000 hr at 1400°F, and to 5000 hr at 1500°F. (auth)

14532 (AI-AEC-13088) ZIRCONIUM HYDRIDE REACTOR CORE HEAT TRANSFER STUDIES SUMMARY REPORT. Marchese, A. R.; Gallegos, A. N. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Jun 1973. Contract AT(04-3)-701. 64p. Dep. NTIS $5.25.

The results are presented of an experimental study showing the influence of rod spacers on the heat transfer to a liquid metal (NaK-78) in turbulent longitudinal flow through a closely spaced rod bundle. The rod bundle consisted of 19 electrically heated elements, which were arranged on hexagonal arrays having a pitch-to-diameter (P/D) ratio of 1:05. Two rod configurations, each with a different type of rod spacer, were investigated. The first configuration utilized ring spacers which were banded to the outer surface of each test rod. For the second configuration, helical-fin spacers were attached to the cladding tubes. Besides maintaining uniform rod spacing, the purpose of the rod spacers was to promote increased fluid turbulence and mixing. Heat transfer results for the cladding circumferential temperature distribution and the rod-average film coefficients were obtained over a range of heating and flow conditions of interest to compact reactor cores. For the rod-average film coefficient, the helical fin configuration showed a significant improvement over the predicted smooth tube results. In the flow range investigated, the heat transfer results were found to be essentially independent of the coolant Peclet number. 14 references. (auth)

14533 (AI-AEC-13092) SPACE NUCLEAR SYSTEM EXPANSION JOINTS SUMMARY REPORT. Whitaker, W. D.; Shimazaki, T. T. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Jun 1973. Contract AT(04-3)-701. 27p. (NASA-CR-121209). Dep. NTIS $3.50.

The engineering, design, and fabrication status of the expansion joint unit (EJU) to be employed in the NaK primary coolant piping loop of the 5-kW(e) Reactor Thermoelectric System are described. Four EJU's are needed in the NaK primary coolant piping loop. The four EJU's, which will be identical, utilize bellows as the flexing member, are hermetically sealed, and provide double containment. The bellows are of a nested-formed design, and are to be constructed of 1-ply thickness of 0.010-in. Inconel 718. The EJU's provide a minimum piping load margin of safety of +0.22. 3 references. (auth)

14534 (AI-AEC-13095) THERMOELECTRIC PUMP PERFORMANCE ANALYSIS COMPUTER CODE. Johnson, J. L. (Atomics International Div., Canoga Park, Calif. (USA)). 11 Jun 1973. Contract AT(04-3)-701. 24p. (NASA-CR-121204). Dep. NTIS $4.00.

The computer program that has been used to analyze and design dual-throat electromagnetic dc conduction pumps for the 5-kW(e) ZrH Reactor Thermoelectric System is presented. In addition to a listing of the code and corresponding identification of symbols, a discussion of the bases for this analytical model is provided. 6 references. (auth)

14535 (AI-AEC-13098) SYSTEM STATISTICAL RELIABILITY MODEL AND ANALYSIS. Lekach, V. S.; Rood, H. (Atomics International Div., Canoga Park, Calif. (USA)). 8 Jun 1973. Contract AT(04-3)-701. 53p. (NASA-CR-121205). Dep. NTIS $5.45.

A digital computer code was developed to simulate the time-dependent behavior of the 5-kW(e) Reactor Thermoelectric System. The code was used to determine lifetime sensitivity coefficients for a number of system design parameters, such as thermoelectric module efficiency and degradation rate, radiator absorptivity and emissivity, fuel element barrier defect constant, beginning-of-life reactivity, etc. A probability distribution (mean and standard deviation) was estimated for each of these design parameters. Then, error analysis was used to obtain a probability distribution for the system lifetime (mean = 7.7 years, standard deviation = 1.1 years). From this, the probability that the system will achieve the design goal of 5 years lifetime is 0.993. This value represents an estimate of the degradation reliability of the system. 3 references. (auth)

14536 (EUR-4820(Vol.5)(Pt.J), pp 407-430) MODEL TEST TECHNIQUE FOR THE PROTECTION STRUCTURES OF REACTOR SHIPS. Woisin, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Collision tests using a bow and a side model have been carried out in Japan and in Italy and in 1967 in a small series of three tests in Western Germany. The models were structures almost exactly simulated to the real ships in the potentially damaged zones. The model scale of 1 to 7.5 was large compared to the Japanese and the Italian tests. The reason for the large scale model was to be able to weld all the joints in the models without simplifications of the structure, and without large dislocations in fabrication. The tests took place at Hamburg on a test stand specially built, with a truck of about 23 tons weight and with the bow model on its front side, accelerated up to 10 m/s by running down an inclined rail. At the end of the rail the truck hit the side model which was fixed to the ground. The ends of the models must be stretched equivalent to the responses in the real ships, as far as the kind of damages is influenced by them. No special arrangements are needed in this respect to the bow model, in the normal case of a test simulating a right-angled collision without speed of the rammed ship. The side model had a special bending girder which simulates the horizontal bending of the rammed ship to the side shell of the model. In that way the tensile-tie effect of the side shell observed many times before in similar foreign tests, which apparently does not appear in real collisions, was avoided. In tests of this kind the bow models are folded in a symmetrical and regular way like an accordion. In one case the damages seem to be unrealistic. But in reality exactly right-angled impacts without any speed of the rammed ship very seldom occur. In collision model testing there is no chance to simulate other collisions because those would need still much more expensive testing arrangements. (auth)

14537 (LA-5285-MS) RECOMMENDED USE OF SI UNITS IN THE NUCLEAR ROCKET ENGINE PROGRAM. Bohl, R. J. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 26p. Dep. NTIS $4.00.

Basic technical information is given for using the international system of units (SI) that has been adopted recently for reporting all Nuclear Rocket Engine Program technical work. Special problems are discussed and some modifications to the SI system are introduced, which are dictated by the special needs of the Nuclear Rocket Engine Program. Some background of the SI system and the considerations that led to its adoption for the Nuclear Rocket Engine Program are also reviewed. (auth)

14538 (N-73-12694) DEVELOPMENT OF A MODEL AND TEST EQUIPMENT FOR COLD FLOW TESTS AT 500 ATM OF SMALL NUCLEAR LIGHT BULB CONFIGURATIONS. Jaminet, J. F. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1972. Contract SNPC-70. 27p. (NASA-CR-129501; L-910900-14). NTIS.

A model and test equipment were developed and cold-flow-tested

at greater than 500 atm in preparation for future high-pressure rf plasma experiments and in-reactor tests with small nuclear light bulb configurations. With minor exceptions, the model chamber is similar in design and dimensions to a proposed in-reactor geometry for tests with fissioning uranium plasmas in the nuclear furnace. The model and the equipment were designed for use with the UARL 1.2 -MW rf induction heater in tests with rf plasmas at pressures up to 500 atm. A series of cold-flow tests of the model was then conducted at pressures up to about 510 atm. At 504 atm, the flow rates of argon and cooling water were 3.35 liter/sec and 26 gal/min, respectively. It was demonstrated that the model is capable of being operated for extended periods at the 500-atm pressure level and is, therefore, ready for use in initial high-pressure rf plasma experiments. (auth)

14539 (N-73-12697) ANALYTICAL DESIGN AND PERFORMANCE STUDIES OF NUCLEAR FURNACE TESTS OF SMALL NUCLEAR LIGHT BULB MODELS. Latham, T. S.; Rodgers, R. J. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1972. Contract SNPC-70. 87p. (NASA-CR-129296; L-910900-17). NTIS.

Analytical studies were continued to identify the design and performance characteristics of a small-scale model of a nuclear light bulb unit cell suitable for testing in a nuclear furnace reactor. Emphasis was placed on calculating performance characteristics based on detailed radiant heat transfer analyses, on designing the test assembly for ease of insertion, connection, and withdrawal at the reactor test cell, and on determining instrumentation and test effluent handling requirements. In addition, a review of candidate test reactors for future nuclear light bulb in-reactor tests was conducted. (auth)

14540 (NAA-SR-6320(Vol.2)) MERCURY RANKINE PROGRAM (SNAP 2). Development of Liquid-Mercury-Lubricated Bearings. Volume II. Plain Bearing Experimental Results. Decker, O. (TRW Equipment Labs., Cleveland, Ohio). [nd]. Contract AT(11-1)-GEN-8. 60p. (TRW-ER-6041(Vol.2)). Dep. NTIS $5.00.

Declassified 17 Apr 1973.

The performance characteristics of the plain (axial groove) journal bearings are presented. The influence of turbulent or superlaminar flow conditions in the clearance space on major parameters is established. Laminar flow equations for load capacity and power loss are modified by Reynolds number terms to account for the flow conditions in the clearance space although the plain journal bearing meets many of the turboalternator requirements. Its inherent instability, susceptibility to cavitation-erosion damage, and sensitivity to load direction prevent its further development. (auth)

14541 (NAA-SR-6691) SNAP 2 NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT PROGRESS REPORT, APRIL–JUNE 1961. Shackelford, M. (Ed.) (Atomics International, Canoga Park, Calif.). 15 Oct 1961. Contract AT(11-1)-Gen-8. 71p. Dep. NTIS $5.75.

Declassified 17 Apr 1973.

Progress is reported covering the flight system configuration, system analysis, instrumentation, component development, nonnuclear system, and operation analysis. Design effort during the report period was directed toward updating the system configuration and design point analysis based upon the latest experimental component data. Significant changes in design point parameters during the report period are listed indicating improvement in several component efficiencies. A choice between dual and insulated radiator-condenser technique is to be made on the basis of NaK freezing requirement, power for startup, startup time, and system weight. (auth)

14542 (NAA-SR-6692) PROGRESS REPORT FOR SNAP 8 REACTOR DEVELOPMENT, APRIL–JUNE 1961. (Atomics International, Canoga Park, Calif.). 1 Dec 1961. Contract AT(11-1)-Gen-8. 44p. Dep. NTIS $4.25.

Declassified 17 Apr 1973.

Work conducted under SNAP 8 includes reactor control, fuel, coolant, core engineering, and test facility. Reactor core design has been established. A promising new hydrogen barrier coating for fuel elements has been developed. The SER (SNAP Experimental Reactor) test facility has been modified to accommodate the S8ER (SNAP 8 Experimental Reactor) which will be used for the first reactor test in the SNAP 8 development program. April 1962 has been set as the startup date for the S8ER. (auth)

14543 (NAA-SR-7204) STATUS REPORT S2DR-1 TESTS, MARCH–DECEMBER 1961. Beall, J. P.; May, H. D. (Atomics International, Canoga Park, Calif.). 1 Oct 1962. Contract AT(11-1)-GEN-8. 48p. Dep. NTIS $4.50.

Declassified Oct 1972.

The S2DR-1 is the reactor portion of the SNAP 2 Developmental System which was tested at the Santa Susana facilities. The reactor and associated systems are described. A summary is given of the testing with the initial fuel loading. (auth)

14544 (NAA-SR-8392) SNAP 8 QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1963. Johnson, C. E. (ed.) (Atomics International, Canoga Park, Calif.). 20 Aug 1963. Contract AT(11-1)-Gen-8. 189p. Dep. NTIS $11.50.

Declassified 3 May 1973.

Progress is reported on the SNAP 8 reactor development program including objectives, design description, system analysis, component development, and system tests. Analyses have been performed covering fuel irradiation effects and an overall heat transfer evaluation. Results indicate no significant changes in core components are required. The S8ER core, reflector-control system, and shutdown shield were assembled and checked out. The assembly of S8R reactor mockup subsystems was started. (auth)

14545 (NAA-SR-8589) SNAP 8 EXPERIMENTAL REACTOR FUEL ELEMENT ACCEPTANCE TESTING. Hubbell, H. J.; Nagel, W. E. (Atomics International, Canoga Park, Calif.). 1 Mar 1964. Contract AT(11-1)-GEN-8. 64p. Dep. NTIS $5.25.

Declassified 3 May 1973.

The Quality Test Program followed during the fabrication of the fuel elements for the SNAP 8 Experimental Reactor (S8ER) Core is outlined. The inspection and test methods are described. A summary of the inspection and test results obtained from the 215 fuel elements accepted for use in the S8ER Core is included. Manufacture of the fuel elements for this core was completed, and the elements were delivered. (auth)

14546 (NAA-SR-8613) FINAL REPORT ON THE SNAP 10A PROTOTYPE CRITICAL ASSEMBLY STUDIES. Clifford, D. W. (Atomics International, Canoga Park, Calif.). 30 Apr 1964. Contract AT(11-1)-GEN-8. 59p. Dep. NTIS $5.00.

Declassified 3 May 1973.

A detailed experimental program conducted on the SCA-4C reactor assembly has yielded extensive design information for the SNAP 2/10A flight reactor. The experiments were primarily concerned with core reactivity and buckling measurements, and external reflector studies. The core measurements showed how control of hydrogen and beryllium in the fuel region could be used to control the excess reactivity of the system without excessive flux perturbations. The reflector thickness could be used as a fine adjustment of system reactivity. Data on shutdown margins and drum control were also provided. Additionally, other core parameters and various component and human mockups were studied in an effort to ascertain reactivity worths of core components and possible environmental effects on the system. (auth)

14547 (NAA-SR-8992) SNAP 8 QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1963. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 15 Nov 1963. Contract AT(11-1)-GEN-8. 209p. Dep. NTIS $12.50.

Declassified 3 May 1973.

Progress is reported on the SNAP 8 reactor development program including objectives, design description, system analysis, component development, and system tests. Some reduction of core pressure drop was accomplished. Flight component design and fuel element development are progressing. S8ER wet critical and approach to power tests were initiated, but shut down for test environment repair. The S8 Reactor mockup assembly is virtually completed. Design of the S8DS and the flight prototype test facility are progressing. (auth)

14548 (NAA-SR-9295) HYDROGEN DISSOCIATION PRESSURES OF MODIFIED SNAP FUELS. Johnson, H. E. (Atomics International, Canoga Park, Calif.). 15 Mar 1964. Contract AT (11-1)-Gen-8. 47p. Dep. NTIS $4.50.

Declassified 17 Apr 1973.

Hydrogen dissociation pressures for SNAP 2, 10A, and 8 fuels, which are modified hydrided 90 wt % zirconium–10 wt % uranium alloys, are presented as functions of composition and temperature. Pressures are expressed in the form of isochore plots and equations, where: $\ln P_{atm} = A_0 + A_1 (10^4/T_{^\circ K})$. The values of A_0 and A_1 are determined from third degree polynominal equations, dependent on hydrogen-to-zirconium (H/Zr) atom ratio compositions. Eleven dissociation pressure isochore maps are presented, showing the effect of the modifier at different levels. H/Zr compositions range between 1.40 and 2.00, in 0.05 intervals, showing specific SNAP 2, 10A, and 8 fuel isochore positions. Dissociation pressures for modified hydrided zirconium–uranium fuels were found to be predictably higher than dissociation pressures for unmodified zirconium hydride. (auth)

14549 (NAA-SR-9297) SNAP AEROSPACE SAFETY PROGRAM. Quarterly Technical Progress Report, October–Decem-

ber 1963. (Atomics International, Canoga Park, Calif.). 14 Feb 1964. Contract AT(11-1)-Gen-8. 52p. Dep. NTIS $4.75.

Declassified 17 Apr 1973.

The analysis of data from the RFD-1 was essentially complete and a report was being prepared for publication. A hypervelocity wind tunnel test program was initiated to determine heat rates, forces, and pressures imposed on a typical SNAP reactor during orbital reentry. Analysis of the test data obtained from the arc-jet test program completed this quarter was also initiated. Additional data were compiled from experiments performed as a part of the Fuel Properties Project. Final preparations were made for the SNAPTRAN-3 initial critical experiments at the NRTS. Final assembly of the SNAPTRAN-2 machine was proceeding on schedule. (auth)

14550 (NAA-SR-9590) SNAP 2A QUARTERLY PROGRESS REPORT, JANUARY-MARCH 1964. (Atomics International, Canoga Park, Calif.). 15 Jun 1964. Contract AT(11-1)-Gen-8. 113p. Dep. NTIS $7.75.

Declassified 17 Apr 1973.

The reference design objective for the SNAP 2 reactor was revised resulting in the SNAP 2A reactor concept. Design data for the SNAP 2A are presented, and experiments are described in the areas of fuel development, component development, and system development. (auth)

14551 (NAA-SR-9597) PROGRESS REPORT SNAP AEROSPACE SAFETY PROGRAM, JANUARY-MARCH 1964. (Atomics International, Canoga Park, Calif.). 15 May 1964. Contract AT(11-1)-Gen-8. 44p. Dep. NTIS $4.25.

Declassified 14 Apr 1973.

The Phase I series of wind tunnel tests was completed and the data generated by these tests are being analyzed. Arc-Jet test runs, using previously developed calorimeter assemblies, were completed. Additional data were compiled from further experiments conducted as part of the Fuel Properties Project. Drop tests were conducted on three cylindrical test vessels to determine the disassembly characteristics of various configurations. The SNAPTRAN-2 machine was shipped to the NRTS. The SNAPTRAN-3 destructive test was being delayed because of inclement weather conditions. Tests were completed on two of the five TREAT capsules. Further studies of the reactivity effects of soil and soil-water environments were completed. (auth)

14552 (NAA-SR-9593) SNAP 10A NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT. Progress Report, January-March 1964. Stewart, J. (Atomics International, Canoga Park, Calif.). 15 May 1964. Contract AT(11-1)-Gen-8. 166p. Dep. NTIS $10.50.

Declassified 17 Apr 1973.

The 90-day test of the first full-power endurance run on a SNAP 10A system was successfully completed on January 15, 1964. This system, designated FSM-1, is similar to the flight units, except that electrical rather than nuclear heat is used within the reactor core to furnish power. A total of 2336 hr (100 days) of successful operation with a reactor core outlet temperature above 900°F generated 906 kwh of electricity by thermoelectric conversion. The overall system performance was as expected throughout the test. Posttest analysis of all major components is continuing. Test results indicate that the SNAP 10A flight unit will initially produce 565 watts in orbit. Twenty-two flight TE modules are continuing to operate at 110% of design conditions, with five exceeding 200 days of operation. Using these present test data, the overall converter subsystem reliability for surviving acceptance testing, prelaunch, and launch is demonstrated to be 0.996 at 90% confidence. Five flight-type thermoelectric pumps have logged up to 100 days each at the design flowrate and are continuing testing to ascertain total life capability. The first full-qualification expansion compensator has progressed through acceptance level shock and vibration, initial thermal, qualification-level shock and vibration testing, including helium leak checking, satisfactorily. A second nonnuclear flight qualification system, FSM-4, and the first nuclear flight qualification system, FS-1, are approaching the initial pretest checkout phase. (auth)

14553 (NAA-SR-9953) SNAP 8 DRM-1 FUEL ELEMENT END CLOSURE DEVELOPMENT. Dennison, W. F.; Messina, C. P. (Atomics International, Canoga Park, Calif.). 15 Dec 1964. Contract AT(11-1)-Gen-8. 27p. Dep. NTIS $3.50.

Declassified 3 May 1973.

Three proposed end plug designs, for use as the final cladding tube closure (hydrogen seal and tube weld) of the SNAP 8 DRM-1 fuel elements, were evaluated. Hydrogen permeation, thermal endurance, shock, and vibration testing results led to the selection and successful utilization of the Reference Design cup-plug in the fabrication of the DRM-1 fuel elements. (auth)

14554 (NAA-SR-10022(Rev.)) FINAL SNAPSHOT SAFEGUARDS REPORT. Hart, R. S.; Harper, W. T. (eds.) (Lockheed Missiles and Space Co., Palo Alto, Calif.; Atomics International, Canoga Park, Calif.). 20 Mar 1965. Contract AT(11-1)-Gen-8. 432p. Dep. NTIS $23.75.

Declassified 24 May 1973.

A definition of the nuclear hazards and an evaluation of the potential risks associated with the flight test of the SNAP 10A Nuclear Power Unit from launch to reentry to earth are presented. This safety evaluation of the flight test is grouped into three phases: launch to orbit injection; orbit injection until the reactor startup command is given; and reactor startup to reentry. For each phase the analysis includes a description of the procedures, a definition of potential accidents and potential nuclear hazards, and an evaluation of the potential risk to personnel. 92 references. (auth)

14555 (NAA-SR-11164) HYDROGEN IN SNAP SYSTEMS. Atkins, D. F. (Ed.) (Atomics International, Canoga Park, Calif.). 30 Apr 1965. Contract AT(11-1)-Gen-8. 82p. Dep. NTIS $6.25.

Declassified 17 Apr 1973.

Most of the materials and components in the SNAP reactors under development at Atomics International become exposed to hydrogen during reactor operation. The hydrogen, from the zirconium-uranium hydride fuel elements, diffuses and migrates throughout the system before it is expelled to the high vacuum of space. The effects of this hydrogen on materials, components, and overall system performance are examined. Existing information on the behavior of hydrogen on specific materials and reactor components under reactor service environments is presented. Observations of hydrogen influence on the performance of ground test reactors are cited. Current and planned analytical and experimental studies to further elucidate the behavior of hydrogen are outlined, and recommendations are made for further work. It is concluded that hydrogen migration and accumulation present no great threat to the successful operation of the SNAP reactors. Analytical studies do show some potential problem areas, particularly in the Mercury Rankine conversion systems. However, sufficient uncertainties exist in the input data so as to require experimental verification. If these problems are indeed real, it is felt that they can be solved by prudent materials selection and subsystem design. (auth)

14556 (NAA-SR-11206(Add.)) SNAP 10A FS-3 OPERATIONS. Bedford, R. E.; Beall, J. P. (Atomics International, Canoga Park, Calif.). 30 Jun 1966. Contract AT(11-1)-Gen-8. 72p. Dep. NTIS $5.75.

Declassified 8 Nov 1971.

The final report on the nuclear qualification test of the SNAP 10A Flight System No. 3 (S10 FS-3) is presented. This test was terminated after a successful, uninterrupted demonstration at design conditions of 10,000 hr. This was the longest known uninterrupted nuclear reactor operation. This test was conducted at the Santa Susana Nuclear Field Laboratory. The operational history of the test is described and an analysis of the behavior of the system components is given. A more detailed analysis of the reactivity behavior of the reactor is given in NAA-SR-11397, "SNAP 10A Reactor Performance." (auth)

14557 (NAA-SR-11490) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, April-June 1965. Gimera, R. J.; Susnir, J. (Atomics International, Canoga Park, Calif.). 31 Aug 1965. Contract AT(11-1)-Gen-8. 31p. Dep. NTIS $3.75.

Declassified 3 May 1973.

SNAP 10A Reactor fuel elements from the qualification and environmental test programs have completed 1.2 million hours of endurance testing. An analysis was made of the most realistic estimate of fuel element reliability. The S-2 Reactor was tested with successful operation. End-of-life temperature uncertainties are being evaluated. Rubidium vapor pressure, bellows, and convoluted expandable grid plates are being studied. (FS)

14558 (NAA-SR-11547) ENVIRONMENTAL TESTING SNAP 10A FUEL ELEMENTS. Isaacs, J. L. (Atomics International, Canoga Park, Calif.). 25 Dec 1965. Contract AT(11-1)-Gen-8. 69p. Dep. NTIS $5.50.

Declassified 17 Apr 1973.

One hundred and twenty SNAP 10A fuel elements containing normal uranium were subjected to a series of high-level inputs in order to determine the reliability of SNAP 10A fuel elements as a function of the severity of the environment. Fuel elements were subjected to environmental inputs up to 2½ times more severe than the qualification level inputs. All fuel elements completed the program without having a hydrogen (moderator) loss rate exceeding the defined failure limit of 2.0 cc (STP)/hr at 1200°F, which is equivalent to 0.0375 cc (STP)/hr at SNAP 10A operating conditions. Ten elements which successfully completed the pro-

gram were given some additional tests. Foremost among these was a 1400°F endurance test. This temperature, which is more than 300°F higher than the reactor temperature, caused only slight damage to the elements. Operation of a SNAP 10A reactor was simulated by a computer code, FUSAK. It was found that the reactor would have lost 3.2¢ of reactivity if the actual reactor elements performed identically to the elements in this program. This represents a 10.75°F drop in reactor operating temperature. Two methods were used to determine fuel element reliability. The first (demonstrated reliability) was limited by the number of elements tested and the fact that no elements failed. This method gave a conservative estimate of 99.52%. The other method had no restrictions, and it gave a much more realistic estimate of 99.979% for one element to successfully withstand all inputs. For a core load of 37 fuel elements, this corresponds to a reliability of 99.926%, as compared to the reliability goal of 99.5%. Suggestions for future work are given; and all fuel elements in this program have been stored, in the event future testing is desired. (auth)

14559 (NAA-SR-11964) IRRADIATION STABILITY OF SCB-1 COATED HASTELLOY N SNAP 8 FUEL CLADDING EXPERIMENTS NAA 77-2 AND NAA 77-3. Engberg, C. J.; Miller, K. J.; Courtright, R. C. (Atomics International, Canoga Park, Calif.). 30 Jun 1966. Contract AT(11-1)-Gen-8. 63p. Dep. NTIS $5.25.

Declassified 17 Apr 1973.

NAA 77-2 and NAA-77-3 were the second and third irradiation experiments designed to determine the radiation stability of SCB-1 hydrogen barrier material. Each capsule contained a single SCB-1 coated SNAP 8 fuel cladding assembly, designed to determine both neutron and fission fragment bombardment irradiation effects. The capsules were irradiated in the Engineering Test Reactor from March 1964 to February 1965, during which time the capsules received a calculated fast neutron dosage of 1.5×10^{21} nvt ($E_n > 1$ MeV), a thermal dosage of 2.5×10^{21} nvt, and a fission fragment bombardment of 1.3×10^{18} fission fragments/element inch. The in-pile hydrogen permeation measurements revealed that the ionizing radiation field in the reactor did not significantly alter the hydrogen permeation process in SNAP 8 fuel cladding assemblies. Radiation does appear to accelerate the devitrification process in the hydrogen barrier material. The permeation rates during the final day of irradiation were 2.8×10^{-3} cc/hr-cm for NAA 77-2, and 2.7×10^{-3} cc/hr-cm^2 for NAA 77-3, at 1500°F and 1 atm hydrogen pressure. These rates may be compared with pre-irradiation permeation rates of 1.0×10^{-3} and 0.88×10^{-3} cc/hr-cm^2 at 1500°F and 1 atm hydrogen pressure for 77-2 and -3, respectively. The capsules operated for 4638 hr at temperatures of 1300 and 1500°F for 77-2 and -3, respectively. The internal hydrogen pressure was maintained at 3 atm absolute, which resulted in a hoop stress in the cladding of ~1200 psi. Measurements showed the diameters of the Hastelloy N cladding tubes had increased 0.08 and 0.37% for 77-2 and -3, respectively. An additional 0.07% increase was measured at the thermocouple strapping bands on each tube. The higher temperature under the thermocouple bands must have caused this higher creep rate. The average creep rates for 77-2 and -3 were determined, from pre-irradiation and postirradiation measurements, to be 3.5×10^{-7} and 1.0×10^{-6} in./in.-hr, respectively. The Hastelloy N cladding material experienced grain growth, similar to that for unirradiated samples annealed under similar conditions. On thermal annealing of both the irradiated and unirradiated material, the Hastelloy N grain boundaries became decorated with precipitated particles. The weld zone showed precipitates within the grains, on both irradiated and unirradiated samples. The NAA 77 series of experiments showed that the SCB-1 ceramic material would meet or exceed the specifications required for the operation of the SNAP 8 hydrogen barrier under normal reactor operating conditions. (auth)

14560 (NAA-SR-12027) END-OF-LIFE SHUTDOWN FEASIBILITY STUDIES. Young, W. A.; Graham, W. H. (Atomics International, Canoga Park, Calif.). 30 Jun 1967. Contract AT(04-3)-701. 44p. Dep. NTIS $4.25.

Declassified 17 Apr 1973.

The feasibility of incorporating tritium into SNAP fuel to provide an inherent end-of-life shutdown mechanism has been investigated. These studies show that, for nonirradiated fuel: tritium redistributes sufficiently rapidly in the fuel to attain a uniform concentration in <72 hr at 1300°F during tritiding, the rate of release of helium-3 from fuel is such that a loss of ~5% will occur in 5 yr, the permeability of SNAP 8 fuel cladding to tritium is ~10% of its permeability to hydrogen, and the concentration of helium-3 produced in 1 yr by dissolution of tritium in Hastelloy N cladding will be ~2 ppb, for initial tritium loadings of 1.6×10^{19} atoms/cm^3 of fuel. The feasibility of a process for the incorporation of tritium into SNAP fuel rods has been demonstrated. (auth)

14561 (NAA-SR-12374) REACTOR POWER PLANTS FOR LUNAR BASE APPLICATION. Gylfe, J. D.; Van Osdol, J. H.; Keshishian, V.; Bedford, R. E. (Atomics International, Canoga Park, Calif.). 30 Jun 1967. Contract AT(04-3)-701. 219p. Dep. NTIS $13.00.

Declassified 31 Oct 1972.

The results of a 12-month study performed by Atomics International for the Atomic Energy Commission as part of a joint AEC-National Aeronautics and Space Administration study of reactor power systems for manned lunar base applications are presented. Several SNAP 8 type reactor and shield designs suitable for use with various types of power conversion systems in the lunar mission and two complete reactor-thermoelectric lunar power plant designs are presented. (auth)

14562 (NAA-SR-Memo-8215(Pt. 4)) SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) TECHNICAL BRIEFS, PART 4, SNAP 8. Johnson, C. E.; Maki, L. M.; Mason, D. G.; Meyers, G. W.; Coombs, M. G.; Steele, O. P.; Donovan, E. J.; Nakae, T. S.; Giles, S.; Howell, J. D.; Hove, F. S. (Atomics International, Canoga Park, Calif.). 15 Mar 1963. Contract AT(11-1)-Gen-8. 72p. Dep. NTIS $5.75.

Declassified 3 May 1973.

SNAP-8 is a reactor-fueled electric power generating system for providing a minimum of 35 kW of power during unattended operation in a space environment for 10,000 hr. The system development, performance requirements, reactor design, materials selection, fuel development, shielding, control system, program scheduling, test facilities, and program status as of March 1963 are presented. (LCL)

14563 (NAA-SR-Memo-8405) ATOMICS INTERNATIONAL CONTRIBUTION TO THE 16th HIGH TEMPERATURE FUELS COMMITTEE, SECTION II. (Atomics International, Canoga Park, Calif.). [nd]. 15p. Dep. NTIS $3.00.

Declassified 17 Apr 1973.

The status of in-progress SNAP fuel irradiations is presented. The effect of additive content, hydrogen content and temperature on the ultimate tensile strength (UTS) and Young's modulus of hydrided Zr-1OU is shown graphically. Optimum mechanical properties are attained at an additive content of 0.15 wt. %. Increasing carbon produces increased brittle character. The onset of slight ductile character appears at temperatures above 1350°F for a H/Zr ratio of 1.74. SNAP 2/10A fuel elements are shown to be capable of withstanding vibration and shock simulating launch condition and thermal cycling, ramp heating, and thermal endurance tests simulating startup and operation without apparent detrimental effect. Based on limited results of nonnuclear performance tests on SNAP 8 elements, they will withstand similar test conditions without failure. Fission gas release from lightly irradiated SNAP fuel materials is being studied by post irradiation annealing. Large variations between samples obtained from given material are sometimes observed. In some, but not all, cases, phase transformations cause large increases in rates of fission gas release. (auth)

14564 (ORNL-4461) EFFECTS OF IRRADIATION ON URANIUM NITRIDE UNDER SPACE-REACTOR CONDITIONS. Weaver, S. C.; Scott, J. L.; Senn, R. L.; Montgomery, B. H. (Oak Ridge National Lab., Tenn.). Oct 1969. Contract W-7405-eng-26. 42p. Dep. NTIS $4.25.

Declassified 10 Apr 1973.

Fifteen UN capsules containing a total of 41 fuel pins were irradiated to burnups up to 4.58 at.% U. The pins contained pressed-and-sintered UN pellets clad in 0.025-in.-thick PWC-11 (Nb–1% Zr–0.1% C) with a 0.005-in. tungsten reaction barrier. Most of the pins operated under SNAP-50 Reference Design No. 3 conditions of 1200°C cladding temperature at linear heat ratings of about 2 kW/ft. To assess the effects of higher burnups and heat ratings, however, four of the capsules were modified to allow the pins to operate at linear heat ratings up to 8 kW/ft but at lower cladding temperatures of 980°C. The fuel pins performed well with no failures despite burnups of up to three times the design burnup and irradiation times up to 12,000 hr. Twenty-two of the 41 fuel pins were successfully tested to the design test time of 10,000 hr; those pins tested less than 10,000 hr did not fail but were removed because they had completed their irradiation testing. All of the fuel pins performed better than the performance criteria of 2.0% increase in pin diameter and 20% release of fission gas as outlined in SNAP-50 Reference Design No. 3. Fuel volume increases exceeded design only in one capsule, which had a burnup of 4.2% and a central temperature of about 1325°C. The PWC-11 cladding showed no effects of corrosion by lithium after the tests. Metallography of the fuel showed that bubbles of fission gas migrated up the temperature gradient and became trapped at grain boundaries. The fuel that was operated to higher burnups (>4 at.% U) showed bubbles of fission gas within the grains as well as at grain boundaries. (auth)

14565 PROPULSION FOR ADVANCED PLANETARY EXPLORATION. Scheib, W. S. Jr.; Johnson, P. G. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 1(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14566 ROTATING FLUIDIZED BED REACTOR FLUID FLOW EXPERIMENTS. Manning, A. J. (Celanese Corp., Summit, NJ); Raseman, C. J.; Ludewig, H. Trans. Amer. Nucl. Soc.; 16: 1-2 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14567 CONVERSION OF PARA- TO ORTHOHYDROGEN IN A RADIATION FIELD. Conant, J. W. (Los Alamos Scientific Lab., NM); Edeskuty, F. J.; Huston, J. E.; Thome, F. V. Trans. Amer. Nucl. Soc.; 16: 2(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14568 BIFOLD NUCLEAR POWER SOURCE. Stubbins, F. (Univ. of Cincinnati); Wolfe, R. A. Trans. Amer. Nucl. Soc.; 16: 51(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14569 COMPACT SPLIT-CORE ISOTOPE-FUELED REACTOR. Breitwieser, R.; Lantz, E. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 16: 51-52(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14570 EXPLORATORY STUDY OF A SATELLITE NUCLEAR POWER STATION (SNPS). Williams, J. R.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 16: 242-243(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14571 NUCLEAR SHIP FUEL MANAGEMENT AND FUEL COSTS. Hagan, R. C.; Anderson, F. N. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 23-24(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14572 ECONOMIC COMPARISON OF NUCLEAR- AND FOSSIL-POWERED CONTAINER SHIP. Dade, T. B.; Witzig, W. F. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 24-25(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14573 UNDERSEA NUCLEAR THERMIONIC REACTOR POWER SYSTEMS. Fisher, C. R.; Allen, D. T.; Carney, H. C. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 26-27(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14574 RADIOISOTOPE AND NONPROPULSIVE REACTOR SYSTEMS FOR NAVY OCEAN REQUIREMENTS. Gans, G. M. Jr. (Naval Facilities Engineering Command, Woodbridge, VA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 26(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14575 REACTOR POWER PLANT FOR UNDERSEA APPLICATIONS. Braiser, R. I.; Mills, C. B. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 27(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14576 REQUIREMENTS FOR THE CALCULATION OF REACTIVITY BALANCES IN SHIP REACTORS AND EXPERIENCE IN THE OTTO HAHN. Goetze, S.; Henssen, H.; Mueller, E. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.). (1973). vp. (In German).

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

The core of ship reactors has to be planned for a longer operating period than stationary reactors, and the means of adjusting deviations from the calculated reactivity curve are limited. Hence more exact reactivity predictions are required. As reversible reactivity changes have to be compensated by using control rods rather than boric acid, and as the long-term shimming of ship reactors with boric acid is subject to certain restrictions (losses in neutron economy) it is aimed at compensating the burnup reactivity by means of burnable poisons to such an extent that only a very low percentage reactivity has to be compensated by boric acid. The assessment of the accuracy of k(eff) calculations is based on recalculations of critical experiments with boric acid with respect to the EDFR-0 and the EDFR-2 core and the corresponding stuck-rod events. The positions of control rods, measured during the operation of the FDR-1, have been used to obtain data on the burn-up time. (GE)

14577 COMPACT REACTOR POWER SYSTEMS. Brunings, J. E.; Mason, D. G.; Thomson, W. B. (Atomic International, Canoga Park, CA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 34(1973).

See CONF-730427.

Reactor Safety and Environmental Aspects

Refer also to abstracts 12862, 12881, 14674, 14713, 14849, 15005, and 15009.

14578 (AI-AEC-13060) LMFBR SAFETY PROGRAMS. Quarterly Technical Progress Report, January-March 1973. (Atomics International, Canoga Park, Calif.). 15 May 1973. Contract AT(04-3)-824. 17p. Dep. NTIS $4.00.

A two-cell sodium pool burning test was performed in which the two cells were connected by two openings. The objective of this test was to evaluate a calculational model, SOFIRE-II, concerning the characterization of a sodium fire in which gas flows in one opening and out the other. In order to compare the effect of two openings with the effect of one opening on sodium burning rates and cell pressure, the cross-sectional area of the two openings was made the same as that of the single opening used in previous two-cell tests. Comparison of the predicted and measured results for two-hole forced-draft two-cell sodium pool burning showed that for approximately 80% monoxide production, the prediction of peak pressure is relatively close to that observed. If 100% monoxide is assumed, the model will conservatively predict the pressure rise. Models of single opening pool fires in two-cell geometry were shown to be very conservative with respect to experiments when 100% monoxide is assumed to be produced. The observed initial pressure rise and decay during and immediately after the spill is not adequately predicted by the code. (LCL)

14579 (CONF-710606-20) FFTF BARRIERS TO FUEL FAILURE PROPAGATION. Wattelet, P. L.; Coffield, R. D. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). 1970. 3p. Dep. NTIS $3.00.

From 17th annual meeting of the American Nuclear Society; Boston, Massachusetts, USA (13 Jun 1971).

The safety margins against fuel failure propagation in the FFTF are discussed. Barriers against fuel failure propagation include the fuel pin cladding, the subassembly duct wall surrounding failed pins and the subassembly duct adjacent to a failed subassembly. In addition the lower structure of the subassembly including the reflector, flow distribution block, and shield block may serve as a barrier to long term fuel slumping and indirect propagation to neighboring subassemblies. (JWR)

14580 (CONF-730628-1) FUEL FAILURE MOCKUP: SODIUM FACILITY FOR TESTING SIMULATED NUCLEAR FUEL ASSEMBLIES. Gnadt, P. A.; Penland, H. E.; Mills, G. E. (Oak Ridge National Lab., Tenn.). 1973. Contract W-7405-eng-26. 14p. Dep. NTIS $3.00.

From 9th annual meeting of ASCET; Phoenix, Arizona, USA (27 Jun 1973).

The design, operation, instrumentation, use, and two-year performance of the Fuel Failure Mockup, a sodium facility for safety studies related to breeder reactor fuel element failure, are described. (LCL)

14581 (EUR-4820(Vol.2)(Pt.C), pp 245-260) FUEL-CLAD DEFORMATION ANALYSIS USING THE SAS1A FAST REACTOR ACCIDENT CODE. Agrawal, A. K.; Dickerman, C. E.; Rothman, A. B. (Argonne National Lab., IL). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An analytical approach to the study of results from fuel failure experiments in the Transient Reactor Test (TREAT) facility is described. Both heat transfer and fuel-clad deformation calculations are based on an idealized single-pin configuration as programmed in the fast reactor Safety Analysis System modular code SAS1A. Detailed analyses are described for several fuel failure threshold experiments, employing UO_2-PuO_2 fresh

pelleted fuel in stainless steel cladding tubes with liquid sodium flow rates simulating typical LMFBR conditions. (auth)

14582 (EUR-4820(Vol.2)(Pt.C), pp 325-345) FUEL FAILURE PROPAGATION AND SOME ASPECTS OF DESIGN-SAFETY INTERACTION IN LMFBR. Khan, E. U. (Babcock and Wilcox Co., Lynchburg, VA). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Under normal or near normal operating conditions there are potentially four causes of fuel failure propagation in LMFBR's. These are briefly described. Models have been developed to predict the possibility of fuel failure propagation within the core. These have shown that fission gas-blanketing should not lead to failure propagation beyond one assembly. It appears that the detrimental effect of nuclear transients occurring during normal operation on fuel failure propagation can be designed out. Thus, small scale flow blockage caused by pin motion, cladding deformation of an initially defective pin, fuel swelling and fuel debris are the most serious mechanism which could lead to fuel failure and to fuel failure propagation. A reactor core with good coolant mixing and strong, well designed assembly cans may delay propagation of failure to other assemblies. Any delay in failure propagation may be as good as preventing it if there are adequate detection devices with timely operation of counteraction systems. (auth)

14583 (EUR-4820(Vol.3)(Pt.E), pp 99-120) PRESSURE VESSEL LOADING DUE TO A CHANNEL RUPTURE IN A PRESSURE TUBE REACTOR. Fasoli-Stella, P.; Guerri, L.; Holtbecker, H. (Euratom, Ispra, Italy). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The present state of knowledge concerning the loading of a vessel of a pressure tube reactor during a channel rupture accident is discussed. Tests were performed in which water-cooled channels were exploded at 264°C and 50 atm. The results show that the pressure peaks generated in the water are due to the fast expansion and recondensation of a big vapor bubble in the first 0.1 s after the explosion. The condensation velocity of this bubble and the collapse pressure are calculated and the results are compared with experimental data. (auth)

14584 (EUR-4820(Vol.3)(Pt.E), pp 129-146) EULERIAN STUDY OF PROPAGATION OF FAST REACTOR EXCURSION. Marchertas, A. H.; Gvildys, J. (Argonne National Lab., IL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An Eulerian method is described which is specifically designed to study the propagation of fast reactor excursions and their effects on the surroundings. The method is based on what has been referred to as the Particle-in-Cell (PIC) technique. A provision of a solid boundary, which is able to move under an imposed pressure, is incorporated into the procedure. Comparison of sample results is made with those obtained by means of a corresponding Lagrangian solution. A simulated plug-jump problem is illustrated and the difficulties encountered described. The capability of monitoring possible coolant spillage to the outside of primary containment by means of the proposed method is pictorially illustrated and discussed. (auth)

14585 (EUR-4820(Vol.3)(Pt.E), pp 147-168) RELIABILITY OF COMPUTER PREDICTIONS OF THE HYDRODYNAMICS OF REACTOR EXCURSIONS. Ash, J. E. (Argonne National Lab., IL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Large computer codes can be used to determine numerically the loadings and strains exerted upon reactor structures by an accidental rapid energy release. The processes which occur during a reactor excursion are extremely complex and difficult to analyze in sufficient detail. One method for predicting the damage to be expected has been to perform model experiments. An alternative method is based upon the use of computer codes which can permit greater flexibility in parametric studies and can reveal internal details of the phenomena. Although the computer code is more expedient as a design tool for reactor safety, the reliability of the predictions based upon a computer code should be established by comparison with experimental results. It is shown that direct computer code calculations can successfully reproduce experimental data from tests involving simplified models of reactor structures in which the nuclear energy release is represented by chemical explosives. The computer code calculations were made with the Reactor Excursion Containment Code System (REXCO), developed at Argonne National Laboratory to predict the effects of excursions originating at the core upon the components and on the containment system of Liquid Metal Fast Breeder Reactors. To test the reliability of the code-predicted loads for the time period immediately following core explosion, comparisons are made with published experimental data. Data are selected from model excursion experiments conducted at A. W. R. E., Foulness, England; at Cadarache, France, by the CEA-Euratom and the UKAEA; and in the United States by the Naval Ordinance Laboratory. The results of these comparisons confirm the capability of the REXCO code system to predict the early-time response of the primary system components and of containment structures to the generated pressure waves. (auth)

14586 (EUR-4820(Vol.3)(Pt.E), pp 169-187) DYNAMIC RESPONSE OF REACTOR CONTAINMENT TO HIGH-ENERGY EXCURSION. Chang, Y. W.; Gvildys, J. (Argonne National Lab., IL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A numerical method is described for calculating the dynamic response of a primary reactor containment system to a high-energy excursion. Media inside the reactor containment are treated as compressible fluids. Hydrodynamic equations and equations of state of reactor materials are used for calculating the propagation of shock waves emanating from the reactor core, the loads imposed on adjacent structures and components, the damage produced by these loads, and the motion of the coolant. Plate-shell equations are used to determine the dynamic response of the reactor containment in which the containment material is considered to be elastic-plastic, strain-hardening and strain-rate sensitive. In the analysis, all equations are expressed in material coordinates and then set into numerical form by finite-difference equations. Shock discontinuities are eliminated by the introduction of an artificial viscosity. The numerical solution of these finite-difference equations is done on the IBM-360 computer, using the REXCO-H code developed at Argonne National Laboratory. (auth)

14587 (EUR-4820(Vol.3)(Pt.E), pp 189-206) HEAT TRANSFER IN POST BURST ACCIDENT MODELS. Marciniak, T. J. (Argonne National Lab., IL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Continuation of post-burst accident analyses in Liquid Metal Fast Breeder Reactors (LMFBR) from the initial shock phase and into the blast phase necessitates the consideration of heat transfer effects; especially those which have an ameliorating effect upon the destructive work potential of the energy deposited in the core materials. In general, programs to handle conduction, convection, and radiative heat transfer in large, post-burst analysis codes such as REXCO-H would be too unwieldy and would still necessitate specialized models to accomodate intracell heat transfer models such as molten fuel-coolant interactions. The general classification of heat transfer models on both intra- and inter-cell basis for use in the REXCO-H hydrodynamics code is described. Following this general discussion is a detailed account of the incorporation of an intercell conduction model and an intracell fuel-coolant interaction model. Preliminary results from these two models are also included. (auth)

14588 (EUR-4820(Vol.3)(Pt.E), pp 207-221) ENERGY ABSORPTION BY THE CONCRETE BIOLOGICAL SHIELD UNDER SHOCK LOADING. Albertini, C.; Andrighetti, V.; Montagnani, M.; Verheyden, L.; Verzeletti, G. (EURATOM, Ispra, Italy). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Research was initiated about two years ago on the problem of containment of the MCA in the concrete biological shielding. This research has necessitated the development of instrumentation to measure dynamic phenomena created by propagation of pressure waves, generated by a simulated explosion in the core. Once correct measurements of wave velocity and particle velocity had been obtained the following two lines of research were pursued: tests on simplified and reduced-scale models of a biological shield, in order to observe the amount of "scabbing" and to develop technical means for limiting its effects; and study of the equations of state of absorbent materials (i.e., porous concrete) in order to calculate the amount of energy that can be absorbed in case of an accident. The first part of this program has already given results which can be employed in orientating the design of the reactor.

The second part is still in progress and the further results obtained will be communicated during the conference. (auth)

14589 (EUR-4820(Vol.3)(Pt.F), pp 5-27) REACTOR INTERNALS RESPONSE UNDER A BLOWDOWN ACCIDENT. Boehm, G. J. (Westinghouse Electric Corp., Pittsburgh); Lafaille, J. P. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A sudden, double-ended rupture is postulated in a primary coolant pipe of a pressurized water reactor. For this hypothetical accident, waves propagate through the system causing excitation of the reactor internals components. The mathematical approach and modeling techniques used to determine the dynamic behavior of the components to assure a safe shutdown of the reactor are discussed. Vertical and horizontal dynamic responses are obtained by modal analysis and numerical integration of the governing differential equations with consideration for nonlinear effects. The behavior of the fuel assemblies and barrel during this accident is shown. Responses are presented for different reactor sizes. (17 references) (auth)

14590 (EUR-4820(Vol.3)(Pt.F), pp 237-253) STRAP: A COMPUTER CODE FOR THE STATIC AND DYNAMIC ANALYSIS OF REACTOR STRUCTURES. Dearien, J. A. (Aerojet Nuclear Co., Idaho Falls, ID). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The computer code STRAP (Structural Analysis Package), developed to perform static and dynamic analyses of reactor structural systems, is described. The code uses the finite element method to model a structure and an uncoupled model summing procedure to perform the dynamic analysis. The code is a three-dimensional structural analysis code and can be used in the static and dynamic analyses of structures having up to 1000 degrees of freedom. Comparisons between analytical and experimental results are presented. A dynamic analysis of a pressurized water reactor is reported. (17 references) (auth)

14591 (EUR-4820(Vol.3)(Pt.F), pp 255-267) DYNAMIC ANALYSIS OF NUCLEAR EQUIPMENT SUPPORTS. Rigamonti, G.; Dainora, J. (Stone and Webster Engineering Corp., Boston). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Special provisions are made in the design of major equipment supports to accommodate postulated loss-of-coolant or steam line break accidents. Using a large order finite element program, a detailed analysis of an 800 MW(e), 3 loop nuclear steam supply system was performed. The objective was to determine the adequacy of the steam generator and reactor coolant pump supports under dynamic loading conditions in a ruptured loop or induced in one of the two adjacent loops. Results indicate the inadequacy of static analyses when dynamic transients exist and the necessity of a complete analysis to optimize support design. (auth)

14592 (EUR-4820(Vol.5)(Pt.J), pp 177-200) DETERMINATION OF NONSTATIONARY PRESSURE AND TEMPERATURE STRESSES OF REACTOR PRESSURE CONTAINMENTS AFTER LOSS-OF-COOLANT ACCIDENTS. Comparison Between Theoretical and Experimental Results. Brosche, D. (Technische Univ. Munich, Garching, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Experimentally investigated pressure-time histories occurring during the short-term pressurization following a loss-of-coolant accident at the primary system in full pressure containments and pressure suppression systems were compared with corresponding analytical results (computer code ZOCO V), yielding good agreement between theory and experiment. The comparisons for full pressure containments yielded information as regards the thermodynamic state of the steam-air-water-mixture in the containment (thermodynamic equilibrium or its rate of deviation) and the heat transfer conditions at and the temperature-time histories in the containment wall. The comparisons for pressure suppression systems also yielded information on up to which point thermodynamic equilibrium in the wet-well can be assumed, as well as results concerning the values of pressure loss coefficients and the water carry-over of compressible one- and two-phase-two-component flows in the vent pipe which have a strong influence on the pressure-time histories. All information obtained by the comparisons render a better insight into the physical phenomena occurring during a loss-of-coolant accident, and serves to calculate in advance with greater accuracy than until now the stresses upon the reactor containment wall caused by pressure and temperature-time histories. It could be seen that these stresses caused by pressure and temperature are very strong and must be taken into account very carefully for the design of reactor containments. (auth)

14593 (EUR-4820(Vol.5)(Pt.J), pp 203-227) EXPERIENCE WITH THERMODYNAMIC PROBLEMS IN REACTOR BUILDINGS DURING LOSS-OF-COOLANT ACCIDENTS. Risse, D.; Langhans, J. (Technischer Ueberwachungs-Verein e. V., Cologne). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A short introduction is given to the problem of pressure-differences inside reactor buildings during loss-of-coolant accidents and to the fundamental methods of thermodynamic calculations. Subsequently experiences are presented as a result of the application of these calculations to nuclear power plants in operation and under construction. (auth)

14594 (EUR-4820(Vol.5)(Pt.J), pp 237-256) HYPOTHETICAL ACCIDENT OF A SODIUM COOLED FAST BREEDER REACTOR AS BASIS FOR THE DESIGN OF A PRISMATIC CONCRETE CONTAINMENT SYSTEM. Lange, L.; Laue, H. (INTERATOM, Bensberg, Ger.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

For a prismatic concrete containment system of a LMFBR there are presented design criteria which have been derived by dynamic analysis. They essentially appear as pressure buildups within the inner and outer containment as well as transient temperature distributions in the concrete walls. A nuclear excursion in the reactor tank partially or completely filled with sodium is regarded as the design basis. If a complete failure of the normal coolant loops and the emergency cooling system is assumed, the decay heat of the disassembled core and the heat stored in the sodium will be transported out of the reactor tank by sodium evaporation and be dissipated into the inner containment. Chemical reactions between the oxygen traces in the nitrogen atmosphere of the inner containment and sodium vapor or liquid sodium leakages add heat sources which finally result in the pressure load of the containment system and temperature gradients in the concrete walls. The results of an appropriate dynamic computer model are reported and their consequences for the prismatic reference containment system of the sodium cooled fast breeder prototype reactor SNR-300 are discussed. (auth)

14595 (EUR-4820(Vol.5)(Pt.J), pp 299-311) PROTECTION OF SAFETY CONTAINMENTS OF BOILING WATER REACTORS IN THE CASE OF MAXIMUM CREDIBLE ACCIDENT. Mueller, W. F. (AEG-Telefunken, Frankfurt am Main). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The protection of steel containments of boiling water reactors by concrete constructions in the case of maximum credible accident is illustrated by example of the nuclear power plants of Lingen (KWL), Wuergassen (KMW) and Brunsbuettel (KKB). The different concrete constructions are explained and some calculation methods are briefly outlined. Finally an outlook to a concrete containment with pressure suppression systems for BWR is given and problems involved in such design are mentioned. (auth)

14596 (HEDL-SRI-1) SIMULATION OF A HYPOTHETICAL CORE DISRUPTIVE ACCIDENT IN A FAST FLUX TEST FACILITY. Florence, A. L.; Abrahamson, G. R. (Stanford Research Inst., Menlo Park, Calif.). May 1973. 237p. AT.

An experimental program is described that was carried out to investigate the structural response of the primary containment (vessel, head, and primary loop) of the Fast Flux Test Facility (FFTF) when subjected to conditions of a hypothetical core disruptive accident (HCDA). In the program, a calibrated source was developed to simulate the HCDA and instrumented experiments were carried out with the source in several simple models and three complex models consisting of two $1/30$-scale reactor structures and one $1/10$-scale reactor structure with three primary loops. The simple model experiments provided basic response results that facilitated the design of the complex model experiments and that are currently being used in the development of computer codes suitable for HCDA descriptions. The main finding of the complex model experiments, all with a scaled HCDA energy release of 150 MWsec, is that structural integrity was maintained with maximum strains well below the material ductility limits. (auth)

14597 (HEDL-SRI-2) SIMULATION OF A HYPOTHETICAL CORE DISRUPTIVE ACCIDENT IN A FAST FLUX TEST FACILITY.

Florence, A. L.; Abrahamson, G. R. (Stanford Research Inst., Menlo Park, Calif.). May 1973. Contract AT(45-1)-2170. 244p. AT.

Tabulated data are presented from experiments on complex models used to investigate the structural response of the primary containment (vessel, head, and primary loop) of the Fast Flux Test Facility (FFTF) when subjected to conditions of a hypothetical core disruptive accident. (LCL)

14598 (JUL-929-HT-WT) NUCLEAR ENERGY AND THE ENVIRONMENT. Bueker, H.; Jansen, P.; Sassin, W.; Schikarski, W. (Kernforschungsanlage, Juelich (West Germany); Kernforschungszentrum, Karlsruhe (West Germany)). Mar 1973. 126p. (In German). (KFK-1366). Dep. NTIS (U. S. Sales Only) $8.50.

The study deals with the thermal and radiological pollution of waters and the pollution of the atmosphere, particularly with the environmental effects of the nuclear fuel cycle. Four examples have been chosen to discuss the pollution of the atmosphere, namely: local concentrations of contaminants; a comparative evaluation of environmental pollution by the various types of power sources; a comparison of the hazards arising from the different pollutants released to the atmosphere by all types of electricity generating plants; and the environmental effect of the use of nuclear power plants. (GE)

14599 (ORNL-TM-4147) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR JANUARY–FEBRUARY 1973. Non-LMFBR Programs. Cottrell, W. B. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 97p. Dep. NTIS $7.00.

The accomplishments during January and February in the research and development program are summarized. Much of this work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems such as blowdown heat transfer studies. Other major projects include experimental investigations of the attachment of nozzles to shells and the implementation of joint AEC–PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR). Seismic considerations of particular significance in nuclear plant design are evaluated in the seismic program. Several of the above projects are also directly related to another major undertaking, the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and standards for government-owned or -sponsored reactor facilities. The recent activities of the Nuclear Safety Information Center (NSIC) and the Nuclear Safety journal in behalf of the nuclear community are also discussed. Of particular interest in both of these activities is the emphasis on environmental effects. (auth)

14600 (RT/PROT-(72)8) REVISION OF THE RITMO REACTOR HAZARDS REPORT: NEW CALCULATION OF THE MAXIMUM CREDIBLE ACCIDENT AND HYPOTHESIS OF FISSION PRODUCTS RELEASE. Moccaldi, A.; Pedretti, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 9 Dec 1972. 56p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.00.

The RITMO Reactor Hazards Report has been revised and updated. Maximum credible accident has been redefined by taking into account the experimental results obtained during reactor operation. Calculation of power excursion has been carried out by the NCOMEUR code, modified by the inclusion of the external neutron source into the kinetic equations. Although the temperature of fuel plates cladding does not reach dangerous values, a partial release of fission products has been assumed and radiological consequences inside and outside the reactor building have been evaluated. The radiological risk involved by the accident has been found to be within the limits accepted for professional workers and for the external environment. (auth)

14601 HOW STANDARDS ARE PREPARED AND THE ANS ROLE IN STANDARDS SETTING. Chalker, R. G. (Atomics International, Canoga Park, CA). Trans. Amer. Nucl. Soc.; 16: 22-23(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14602 USE AND ROLE OF CODES AND STANDARDS IN THE ARCHITECTURAL ENGINEERING PHASE. Riegelhaupt, P. (Stone and Webster Engineering Corp., Boston). Trans. Amer. Nucl. Soc.; 16: 24(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14603 CODES, STANDARDS, AND THE OPERATOR-OWNER. Bailey, E. C. (Commonwealth Edison Co., Chicago). Trans. Amer. Nucl. Soc.; 16: 24-25(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14604 SUMMARY OF NUCLEAR STANDARDS IN EDUCATION. Eggen, D. T. (Northwestern Univ., Evanston, IL). Trans. Amer. Nucl. Soc.; 16: 25(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14605 DESIGN AND LICENSING ANALYSIS USING THE EMERALD-NORMAL PROGRAM. Gillespie, S. G.; Brunot, W. K. (Pacific Gas and Electric Co., San Francisco). Trans. Amer. Nucl. Soc.; 16: 37-38(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14606 DIVERGENT PUBLIC ATTITUDES TOWARD NUCLEAR AND HYDROELECTRIC PLANT SAFETY. Gast, P. F. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 40-41(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14607 ESTIMATING INITIAL VOIDING CHARACTERISTICS OF AN LMFBR. Stein, R. P. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 179-180(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14608 SINGLE-PIN EXPULSION AND REENTRY TEST. Henry, R. E.; Singer, R. M.; Quinn, D. J.; Spleha, E. A.; Erickson, E. G.; Jeans, W. C. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 180-181(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14609 FIRST TREAT MARK-II LOOP FAILURE THRESHOLD EXPERIMENT WITH PREIRRADIATED FFTF-TYPE FUEL (H-3). Rothman, A. B. (Argonne National Lab., IL); Wright, A. E.; Stahl, D.; Harrison, L. J. Trans. Amer. Nucl. Soc.; 16: 181-182(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14610 FAST-NEUTRON HODOSCOPE VISUALIZATION OF FUEL MOVEMENT IN A 7-PIN LOSS-OF-FLOW SIMULATION. De Volpi, A.; Stewart, R. R.; Deitrich, L. W. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 182(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14611 LOSS-OF-FLOW SIMULATION WITH FRESH FFTF-TYPE FUEL PINS. Deitrich, L. W. (Argonne National Lab., IL); De Volpi, A.; Feay, B. A.; Murphy, W. F.; Harrison, L. J. Trans. Amer. Nucl. Soc.; 16: 182-184(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14612 FRAGMENTATION OF MOLTEN MATERIALS DROPPED INTO WATER. Cho, D. H.; Gunther, W. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 185-186(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14613 NONCOHERENCE AND HEAT TRANSFER CUTOFF IN LMFBR FUEL-COOLANT INTERACTION. Reynolds, A. B.; Erdman, C. A.; Garner, P. L.; Haas, P. M. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 16: 186-187(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14614 EVALUATION OF A BACKUP SAFETY DEVICE FOR LMFBR. Eggen, D. T. (Northwestern Univ., Evanston, IL); Livengood, C. D.; Lewis, E. E.; Shun, R. H. Trans. Amer. Nucl. Soc.; 188(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14615 AXIAL MOLTEN-FUEL MOTION MODEL. Travis, J. R.; Smith, L. L.; Stevenson, M. G.; Fischer, G. J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 188-189(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14616 ACCIDENT MITIGATION FROM MOLTEN FUEL/COOLANT DYNAMICS DURING A FAST REACTOR OVERPOWER EXCURSION. Partain, W. L.; Waltar, A. E. (Westinghouse

Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 189-190(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14617 APPLICATION OF IMPLICIT CONTINUOUS EULERIAN CONTAINMENT CODE TO LOW-ENERGY EXCURSIONS. Wang, C. Y.; Chang, Y. W.; Fistedis, S. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 191-192(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14618 NONLINEAR DYNAMIC-ANALYSIS METHOD FOR FAST REACTOR HEAD COVERS UNDER IMPULSIVE LOADING. Schoeberle, D. F. (Univ. of Illinois, Chicago); Chang, Y. W. Trans. Amer. Nucl. Soc.; 16: 192(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14619 DYSI: DYNAMIC SLUG IMPACT MODEL FOR MECHANICAL CONSEQUENCES ANALYSIS. Madsen, R. N.; Simpson, D. E. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 193(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14620 REACTOR ENERGY SOURCE CHARACTERIZATION. Cagliostro, D. J. (Stanford Research Inst., Menlo Park, CA); Nagumo, G. Trans. Amer. Nucl. Soc.; 16: 193-194(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14621 REDUCTION OF GAS-EXPANSION WORK BY A COLD LIQUID. Epstein, M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 194-195(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14622 ENERGY-DISSIPATION MECHANISM DUE TO THE CLADDING OF THE FISSION-GAS PLENUM DURING AN HCDA. Theofanous, T. G. (Purdue Univ., Lafayette, IN); Fauske, H. K. Trans. Amer. Nucl. Soc.; 16: 195-196(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14623 PLUTONIUM TRANSPORT TO THE SECONDARY CONTAINMENT IN AN LMFBR ACCIDENT. Kennedy, M. F.; Reynolds, A. B. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 16: 196(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14624 MODEL OF FISSION GAS RELEASE FROM FAILED LMFBR FUEL RODS. Fernandez, R. T.; Thomas, G. R. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 197(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14625 LOCAL FLOW STARVATION IN AN LMFBR SUBASSEMBLY DUE TO FISSION GAS RELEASE. Freslon, H. (Northwestern Univ., Evanston, IL); Fauske, H. K.; Eggen, D. T. Trans. Amer. Nucl. Soc.; 16: 197-198(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14626 EVALUATION OF THE POTENTIAL FOR FUEL FAILURE PROPAGATION IN AN FFTF SUBASSEMBLY DUE TO FISSION GAS RELEASE. van Erp, J. B.; Chawla, R. C.; Wilson, R. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 198-199(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14627 FAILURE ANALYSIS OF SUBASSEMBLY FUEL ELEMENTS SUBJECTED TO A PRESSURE-PULSE LOADING. Hibbeler, R. C.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 200(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14628 FFTF FUEL ASSEMBLY DUCT PRESSURE RESPONSE ANALYSIS. McCall, T.; Graham, J. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 200-201(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14629 INFLUENCE OF COOLANT ON HEXAGONAL FUEL-SUBASSEMBLY RESPONSE. Kennedy, J. M. (Argonne National Lab., IL); Belytschko, T. Trans. Amer. Nucl. Soc.; 16: 201-202(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14630 CONTAINMENT ANALYSIS AND FUEL-COOLANT INTERACTIONS: ADDITIONAL CONSIDERATIONS. Bratis, J. C.; Marciniak, T. J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 202(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14631 DESIGN BASIS ACCIDENTS: MARGIN FOR UNKNOWNS. Hanauer, S. H. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 203(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14632 WHY DID WE NEED A DESIGN BASIS ACCIDENT. Bray, A. P.; Ianni, P. W. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 203-204(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14633 DESIGN BASIS ACCIDENTS: PERSPECTIVE IN THE SEVENTIES. Moore, J. S. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 204(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14634 DESIGN BASIS ACCIDENTS FOR FAST REACTORS. Wolfe, B.; Hikido, K.; Meyer, R. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 16: 205(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14635 HTGR DESIGN BASIS ACCIDENTS. Waage, J. M. (Gulf General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 16: 205-206(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14636 PUBLIC PERCEPTION OF THE DESIGN BASIS ACCIDENT. Lapp, R. E. (Energy/Nuclear Consultant, Alexandria, VA). Trans. Amer. Nucl. Soc.; 16: 206-207(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14637 LOSS-OF-TARGET ANALYSES. Reeve, H. R.; Smith, J. A.; Hootman, H. E.; Durant, W. S. (E. I. du Pont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 16: 208(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14638 CONCEPTUAL DESIGN APPROACH TO CONTAINMENT OF A MOLTEN CORE IN LARGE, PRESSURIZED WATER REACTORS. Frank, M. V.; Salem, S. L.; Suo-Anttila, A.; Vasudevan, R. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 16: 208-209(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14639 CATALYST PERFORMANCE FOR POST-LOCA RECOMBINER APPLICATIONS. Benning, M. A.; Klosek, J.; Schmauch, G. E. (Air Products and Chemicals, Inc., Allentown, PA). Trans. Amer. Nucl. Soc.; 16: 209(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14640 AIRPLANE CRASH PROBABILITY NEAR A FLIGHT TARGET. Hornyik, K. (Oregon State Univ., Corvallis). Trans. Amer. Nucl. Soc.; 16: 209-210(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14641 REACTOR SITINGS IN THE VICINITY OF AIRFIELDS. I. Eisenhut, D. G. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 210-211(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14642 PROBABILISTIC ASSESSMENT OF FLOODING HAZARD FOR NUCLEAR POWER PLANTS. Wall, I. B. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 211-212(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14643 PREDICTION OF FLOW OSCILLATION IN REACTOR CORE CHANNEL. Kao, H. S. (Babcock and Wilcox Co., Lynch-

burg, VA); Morgan, C. D.; Parker, M. B. Trans. Amer. Nucl. Soc.; 16: 212-213(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14644 DESIGN CONSIDERATIONS FOR A CONTAINMENT SPRAY ADDITIVE SYSTEM. Agan, C. E.; Edelstein, J.; Sterlin, A. (Pioneer Service and Engineering Co., Chicago). Trans. Amer. Nucl. Soc.; 16: 213-214(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14645 STANDARDS HIERARCHY AND INTERRELATIONSHIPS. Savolainen, A. W. (American National Standards Inst., New York). Trans. Amer. Nucl. Soc.; 16: 223(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14646 STATUS OF NUCLEAR STANDARDS PROGRAM. Prestele, J. A. (Consolidated Edison Co. of New York, Inc., New York). Trans. Amer. Nucl. Soc.; 16: 224(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14647 NUCLEAR STANDARDS: AT A CROSSROAD. Moore, J. S. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 224-225(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14648 STANDARDIZATION: A UTILITY POINT OF VIEW. Bjeldanes, M. N. (Northern States Power Co., Minneapolis). Trans. Amer. Nucl. Soc.; 16: 225(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14649 THERMAL DISCHARGE FROM POWER PLANTS. Erdmann, W. (Kommunales Elektrizitaetswerk Mark AG, Hagen, Ger.). (1973). vp. (In German).
From VGB conference: power plant and environment, 1973; Essen, Germany (27 Feb 1973).
In spite of the fact that the specific heat demand is declining, still more waste heat is being produced in power plants due to an increasing electric power supply. As there are as yet only few possibilities for an economic utilization of the waste heat, it is currently released to the environment via river or sea water cooling, or else through cooling towers which are raising public concern as being harmful to the environment. A solution of the problem has not yet been found and power plants will continue to present a thermal load to the environment for some time to come. (GE)

14650 CONFERENCE ON THE OCEAN, NUCLEAR ENERGY, AND MAN. Transactions of the American Nuclear Society Conference, Palm Beach Shores, Florida, April 25-27, 1973. Farmakes, R. (ed.) Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 1-34(1973). (CONF-730427-).
Summaries of 37 papers are presented. Each summary is listed separately in NSA. (HDR)
For abstracts of individual papers see: 12642, 12799, 12869, 12884, 12885, 12985, 14351, 14571-14575, 14577, 14651-14664, 14849, 14850, and 15009-15016.

14651 OPPORTUNITIES, ISSUES, AND PROBLEMS IN POWER GENERATION BY MAKING USE OF THE OCEANS. Shoupp, W. E. (Westinghouse Electric Corp., Annapolis, MD). Trans. Amer. Nucl. Soc., Supp.; 16: No. 1, 1(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14652 FUTURE SITING REQUIREMENTS FOR OFFSHORE NUCLEAR ENERGY STATIONS. Klepper, O. H.; Anderson, T. D. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 1-2(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14653 FEASIBILITY OF FLOATING NUCLEAR POWER PLANTS ALONG THE CALIFORNIA COAST. Collison, T.; Erdmann, R.; Esteves, R.; Fulton, C.; Kuo, Y.; Libby, L.; Merifield, P.; Okrent, D.; Wada, R.; Weller, J. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 2-3(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14654 PRELIMINARY SITE SEARCH FOR A MAJOR OFFSHORE FACILITY. Schwartz, A.; Rutledge, C. Jr. (Westinghouse Electric Corp., Annapolis, MD). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 3(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14655 PROTECTING OFFSHORE PLANTS FROM SHIP COLLISION. Hammond, R. P. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 3-4(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14656 CONSIDERATIONS OF THE GEOTECHNICAL ENGINEER IN PLANNING TRANSMISSION LINES TO OFFSHORE NUCLEAR POWER PLANTS. Fischer, J. A.; Watson, I.; Salomone, L. (Dames and Moore, Cranford, NJ). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 4-5(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14657 ATOMIC ISLAND-IS IT FAR OFF? O'Leary, J. F. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 8(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14658 EXPLORATORY MODEL STUDIES OF REACTOR PLATFORM MOTIONS. Thomas, D. G.; Sheppard, J. D.; Hammond, R. P. Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 12-13(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14659 APPLICATION OF NUMERICAL SIMULATION MODELS IN THE ASSESSMENT OF THE EFFECT OF DISCHARGES INTO COASTAL WATERS. Gritton, E. C. (Rand Corp., Santa Monico, CA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 14(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14660 ENVIRONMENTAL IMPACT OF A POWER PLANT ON A SUBTROPICAL BAY. Thorhaug, A.; Roessler, M.; Segar, D.; Bader, R.; Gerchakov, S. (Univ. of Miami, FL). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 14-15(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14661 THERMAL ANALYSIS OF THE TURKEY POINT COOLING RESERVOIR. Katterhenry, A. A.; Burford, J. N. (Southern Nuclear Engineering, Inc., Dunedin, FL). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 15-16(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14662 MATHEMATICAL MODEL OF HEATED EFFLUENTS IN COASTAL WATER. Ahn, C. S. (EG and G International Inc., Waltham, MA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 16-17(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14663 CRYSTAL RIVER MARICULTURE RESEARCH PROJECT. More, W. R. (New Venture Management, Crystal River, FL); MacGrath, W. S. Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 21(1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14664 NATURAL CONVECTION COOLING FOR OFFSHORE NUCLEAR POWER PLANTS. Kylstra, C. D. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 21-22 (1973).
From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Reactor Theory and Calculation

Refer also to abstracts 14436, 14515, and 14845.

14665 (AEEW-R-817) CALCULATION OF NUCLEAR REACTOR SPATIAL TRANSFER FUNCTIONS USING THE COMPUTER PROGRAMME XENFER. Owens, D. H. (Atomic Energy Establishment, Winfrith (England)). May 1973. 62p. Dep. NTIS (U. S. Sales Only) $5.25.
A KDF9/EGDON computer program XENFER has been written to calculate transfer functions describing the spatial dynamics of sectorized nuclear power reactors subject to xenon poison effects. The accuracy of the program is analyzed by a comparison with the predictions of an exactly soluble model. A relation is derived expressing the errors in the predicted frequency responses predicted by XENFER due to the approximation used to calculate a set of axial synthesis modes consistent with the input neutron flux

mode. This relation is particularly useful as it expresses the fractional error in the frequency response in terms of parameters calculated and printed out in XENFER. The data and output listing for the case of a hypothetical two-zone "flattened" reactor configuration is included and the rate of convergence of the azimuthal mode series investigated numerically. (auth)

14666 (COO-2262-2) ANNUAL PROGRESS REPORT, FY1973. Hansen, K. F.; Henry, A. F. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Apr.1973. Contract AT(11-1)-2262. 37p. Dep. NTIS $4.00.

Research in space-time reactor dynamics at Massachusetts Institute of Technology during the 1973 fiscal year is described. The research was concerned primarily with the development of numerical methods capable of describing in an economical fashion the space dependent behavior of neutrons during reactor transients. The studies included kinetics methods, the finite element method, equivalent homogeneous constants, and cell stitching techniques. (JWR)

14667 (DUN-7286) USE OF THE HAMMER SYSTEM FOR EVALUATING LIGHT-WATER MODERATED, CRITICAL ASSEMBLIES. Kupinski, A. F.; Toffer, H. (Douglas United Nuclear, Inc., Richland, Wash.). 30 Oct 1970. 73p. Dep. NTIS $5.75.

The HAMMER computer code provides an accurate, reliable system for calculating nuclear parameters for critical assemblies, and provides a more consistent way of calculating criticality parameters than previous methods. For all of the systems analyzed (except for those where the leakage was improperly handled, such as the 4.89 wt % rods or the PuAl rods where the plutonium resonances were handled using the equivalence principle), HAMMER calculated maximum bucklings and minimum critical masses, which deviated less than five percent from the experimental values. HAMMER also properly predicted the shape and orientation of the buckling and critical mass curves with respect to the degree of system moderation (i.e., V_w/V_r). The FLOG critical dimension results also testify to the validity of the THERMOS/HAMLET cross sections for providing accurate lattice nuclear characterizations. Although all of the systems examined in this study were symmetric and easily described by a one-dimensional reactor model (such as FLOG), the cell nuclear parameters calculated by THERMOS/HAMLET could just as reliably be used (as was done in the mixed fuel target lattices and the two-dimensional mockup of the critical mass calculations for the 2.1 fuel) in more sophisticated reactor models, such as two-dimensional diffusion of transport theory models or three-dimensional Monte Carlo models. The HAMMER system not only provides a complete lattice cell and reactor analysis for assemblies, which can be satisfactorily depicted in one-dimension, but also provides valid lattice cell nuclear parameters which can be used in other reactor models to describe complex systems. (auth)

14668 (EUR-4820(Vol.3)(Pt.E), pp 435-452) REACTOR ENGINEERING EFFECTS AS SOURCES OF STOCHASTIC NOISE IN NEUTRON REACTION RATES. Barrett, P. R. (Univ. of New South Wales, Kensington, Australia). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

It is shown how some reactor engineering phenomena cause stochastic noise effects for neutron reaction rates in a reactor and how the deviations from the mean levels of these effects can produce small changes in the reactivity of a fission reactor. Particular reference is made to the introduction of randomness into the media of a reactor resulting from: moderator and/or coolant boiling; the setting up of fuel element and control element vibrations owing to perturbations in the coolant flow; the bowing of fuel elements as a result of significant neutron irradiation; and the randomness involved in the flow of fuel pebbles in a pebble-bed reactor. Other stochastic effects which do not introduce randomness into the reactor medium are illustrated by the feedback on the neutron balance condition in a reactor caused by thermal fluctuations producing changes in neutron cross-sections. (auth)

14669 (FRNC-TH-345) STUDY OF A DIFFERENTIAL MODEL DESCRIBING THE DRYOUT PHENOMENON FOR A TWO-PHASE FLOW IN THE CHANNEL OF A NUCLEAR REACTOR. Sursock, J. P. (Paris Univ., Orsay (France). Faculte des Sciences). [nd]. 116p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis.

A model explaining dryout was developed. The dispersed annular regime is described from experimental observations. An equation representing the changes occurring in the liquid film is established using a perturbation method. The variation of the liquid flow in the film is principally due to evaporation occurring at the interface. This evaporation term is easily calculated from the energy balance equation. A first order corrective term: the detachment is introduced. This term characterizes the detachment of droplets from the top of the waves as has been observed by various experimental workers. The variation of this term with the flow and thickness at each side of the film is calculated. The results obtained (velocity of the waves, amplitude and length of the waves) are in excellent agreement with the experimental results. A second order corrective term is then introduced. This term characterizes the redeposition of the droplets and is calculated using a diffusion method analogous to that used in neutronics. The method is based on Fick's law. The integration of the fundamental equation leads to results, which are in excellent agreement with the experimental results, the mean standard deviation being 3%. (FR)

14670 (FRNC-TH-381) REDUCED REACTOR MODEL FOR CALCULATING THE VARIATION IN FLUX AND REACTIVITY RESULTING FROM A PERTURBATION LOCALIZED IN A FAST NEUTRON MULTIPLYING MEDIUM. Akl, D. (Paris Univ., Orsay (France)). 1972. 127p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

A method is proposed for interpreting oscillation or perturbation experiments using small samples. The propagation of a perturbation in a fast neutron multiplying medium was studied, the perturbations being due to a localized perturbing source. The problem is treated by separating the perturbed flux into a fundamental flux (flux existing in the medium before the perturbation) and a transient flux (flux generated by the source). The study commences with the perturbation theory formalism, and then exposes a method for directly calculating the perturbation of the flux and the activity resulting from the introduction of a perturbing sample at the center of a critical reactor. The problem concerning the calculation for the reactor with or without the sample is replaced by a source problem, the principal component of the source originating from the sample. The normalization condition appearing in the flux perturbation calculation is used to define the reduced reactor model. This is accomplished using the same source calculation for the small volume surrounding the sample and not for the whole reactor. The method is applied to a series of experiments carried out in Ermine: study of the propagation of transient flux produced by a localized source; calculation of the reactivity and perturbation of the flux for a certain number of characteristic samples; establishment of the reduced reactor; calculation of the contribution of flux perturbation to reactivity effects with fissile uranium and plutonium samples; interpretation of reactivity measurements and local signals for plutonium samples as a function of dilution. (FR)

14671 (GEAP-13771-6) CRITICAL EXPERIMENTS AND COOPERATIVE EVALUATIONS PROGRAM. Sixth Quarterly Report, January-March 1973. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Mar 1973. Contract AT(04-3)-893. 67p. Dep. NTIS $5.45.

Information is presented concerning physics measurements for ZPPR Assembly 3, the evaluation of ^{239}Pu data for ENDF/B-4 values, and fuel management calculations. 9 references. (DCC)

14672 (JUL-906-RX) CONTRIBUTION OF THERMAL RADIATION TO THERMAL CONDUCTION OF PEBBLE BEDS IN STAGNANT MEDIA. Leyers, H. J. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente). Dec 1972. 24p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

Heat transfer in randomly packed spheres which is mainly a result of heat conduction and thermal radiation is discussed. The various contributions to the overall heat transfer are represented by equations and special attention is given to thermal radiation. It is shown that a formula describing the thermal radiation can be derived by assuming that the emissivity of the medium, ϵ_M, can be neglected and by giving the thermal conductivity coefficient λ_{eff} when three parameters describing the randomly packed layer of spheres are known, namely: the emissivity ϵ of the spheres; the sphere diameter ϕ, and the packing density p. The equations given are valid for appropriately small differences in temperature with reference to the standard unit of the randomly packed spheres. It is further assumed that heat conduction and thermal radiation are to be added up, with the thermal radiation term being generally smaller than the heat conduction term. An additional correction mode is given for the case of these two terms being equal. (GE)

14673 (STI/DOC-10/143) DEVELOPMENTS IN THE PHYSICS OF NUCLEAR POWER REACTORS. Based on Lectures Presented at the Third International Advanced Summer School in Reactor Physics, Herceg-Novi. Pop-Jordanov, J. (ed.). (International Atomic Energy Agency, Vienna (Austria)). Mar 1973. 291p. IAEA $11.00.

Separate abstracts were prepared for each of the 11 papers included. (JWR)

For abstracts of individual papers see:14306, 14325, 14394, 14706–14712, and 14845.

14674 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1973 ANNUAL MEETING, CHICAGO, ILLINOIS, JUNE 10–14, 1973. Farmakes, R. (ed.). Trans. Amer. Nucl. Soc.; 16: 1-364(Jun 1973). (CONF-730611-).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Included are 375 brief summaries of papers on various aspects of nuclear science and technology. The summaries were presented in technical sessions entitled: Aerospace and Hydrospace; Controlled Nuclear Fusion; Education; Environmental Sciences; Isotopes and Radiation; Materials Science and Technology; Mathematics and Computation; Nuclear Criticality Safety; Nuclear Fuel Cycle; Nuclear Reactor Safety; Power; Reactor Operations; Reactor Physics; and Shielding and Dosimetry. Each summary is listed separately in NSA. (DCC)

For abstracts of individual papers see: 12611–12618, 12644, 12662–12664, 12681, 12768, 12773, 12811, 12818–12823, 12837–12839, 12851–12854, 12859, 12862–12864, 12881, 12887, 12888, 12890–12892, 12932–12935, 12950, 12958, 12969–12971, 12973, 12981–12983, 12986, 12987, 12992, 12993, 13106, 13122–13131, 13179, 13212, 13260–13262, 13317–13333, 13367, 13368, 13396, 13397, 13401, 13408–13421, 13425–13428, 13433, 13578, 13979–13986, 14007, 14042, 14053, 14063, 14105–14111, 14176, 14191, 14205–14214, 14230–14233, 14247–14251, 14303–14305, 14312–14324, 14340–14347, 14379–14383, 14392, 14393, 14431–14464, 14485–14519, 14524, 14565–14570, 14601–14648, 14675–14705, 14805–14811, 14827, 14828, 14837–14844, 14851–14857, 15004–15008, 15017, 15024, 15025, 15174, and 15175.

14675 MULTIGROUP CROSS-SECTION GENERATION FOR THERMAL REACTORS. Dannels, R. A.; Raymund, M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 124-125(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14676 SHIELDING FACTOR METHOD FOR GENERATING MULTIGROUP CROSS SECTIONS. Kidman, R. B.; Hardie,.R. W.; Schenter, R. E. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 16: 125-126(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14677 METHODOLOGY AND APPLICATION OF THE MC^2-2/SDX CROSS-SECTION CAPABILITY. Toppel, B. J.; Henryson, H. II (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 126-127(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14678 MINX: A MULTIGROUP INTERPRETATION OF NUCLEAR X SECTIONS. Weisbin, C. R. (Los Alamos Scientific Lab., NM); Soran, P. D.; Harris, D. R.; LaBauve, R. J.; Hendricks, J. S. Trans. Amer. Nucl. Soc.; 16: 127-128(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14679 COMPARISON OF MC^2 AND SDX FOR DATA TESTING ASSEMBLIES. Pennington, E. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 128-129(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14680 SOME MATHEMATICAL ASPECTS OF FINITE ELEMENT CALCULATIONS. Kellogg, R. B. (Univ. of Maryland, College Park). Trans. Amer. Nucl. Soc.; 16: 131(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14681 CURRENT FINITE ELEMENT ANALYSIS PRACTICES. Mallett, R. H.; Disney, R. K. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 131-132(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14682 APPLICATION OF THE FINITE ELEMENT METHOD TWO DIMENSIONAL DIFFUSION PROBLEMS. Deppe, L. O.; Hansen, K. F. (Massachusetts Inst. of Tech., Elmford, NY). Trans. Amer. Nucl. Soc.; 16: 132-133(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14683 FAST CONVERGENT SPACE-AND-ENERGY-POINTS TRANSPORT THEORY METHOD. Bosevski, T.; Pop-Jordanov, J. (Boris Kidric Inst. of Nuclear Science, Belgrade). Trans. Amer. Nucl. Soc.; 16: 133-134(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14684 FLUX SYNTHESIS CALCULATIONS FOR FAST REACTORS. Adams, C. H.; Stacey, W. M. Jr. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 135(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14685 SYNTHESIS AND FEW-GROUP ANALYSIS OF FAST REACTOR TRANSIENTS. Terney, W. B.; Srivenkatesan, R. (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.; 16: 135-136(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14686 APPROXIMATION OF THE TRANSPORT EQUATION BY EXPANSION IN WALSH FUNCTIONS. Albrecht, R. W.; Seed, T. J. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 16: 136-138(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14687 MONTE CARLO SOURCE BIASING OPTIMIZATION. Hoffman, T. J. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 139(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14688 CALCULATION OF SYSTEM RELIABILITY BY PATTERN RECOGNITION. Koen, B. V. (Univ. of Texas, Austin); Carnino, A. Trans. Amer. Nucl. Soc.; 16: 141-142(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14689 ENERGY-DEPENDENT SPATIAL MESH APPROXIMATION FOR STATIC FEW-GROUP DIFFUSION EQUATIONS. Natelson, M.; Yasinsky, J. B.; Rampolla, D. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 16: 143-144(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611–.

14690 REDUCTION OF NUMERICAL ERRORS ASSOCIATED WITH TWO DIMENSIONAL REFLECTION MATRICES. Filippone, W. L. (Instituto Politecnico Nacional, Mexico City). Trans. Amer. Nucl. Soc.; 16: 144-145(June 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14691 DIFFUSION EQUATION AND CELL HOMOGENIZATION MADE RIGOROUS. Bonalumi, R. A. (CISE, Milan). Trans. Amer. Nucl. Soc.; 16: 285(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14692 AREA-RATIO METHOD OF REACTIVITY DETERMINATION IN REFLECTED REACTORS. Kosaly, G.; Valko, J. (Central Research Inst. of Physics, Budapest). Trans. Amer. Nucl. Soc.; 16: 287-288(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14693 DIRECT METHODS FOR MULTIDIMENSIONAL KINETICS PROBLEMS. Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 16: 291-292(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14694 SPACE-DEPENDENT TRANSIENT REACTOR EXPERIMENTS AND CALCULATIONS AT SAVANNAH RIVER LABORATORY. Dodds, H. L.; Parks, P. B.; Bailey, C. E.; Baumann, N. P.; Currie, R. L.; Stewart, J. W. (E. I. du Pont de Nemours and Co., Aiken, SC). Trans. Amer. Nucl. Soc.; 16: 292-293(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14695 GENERALIZED SOURCE MULTIPLICATION METHOD. Greenspan, E. (Princeton Univ., NJ). Trans. Amer. Nucl. Soc.; 16: 296-297(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14696 OPTIMAL SOURCE PROJECTION METHOD TO ACCELERATE SPACE-TIME-DEPENDENT CALCULATIONS. Saphier, D. (Soreq Nuclear Research Center, Yavne, Israel). Trans. Amer. Nucl. Soc.; 16: 300-301(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14697 EXACT DOPPLER BROADENING OF EVALUATED NEUTRON CROSS SECTIONS. Cullen, D. E. (Univ. of California, Livermore); Ozer, O.; Weisbin, C. R. Trans. Amer. Nucl. Soc.; 16: 320-321(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14698 CHARACTERIZATION OF UNCERTAINTIES IN EVALUATED CROSS-SECTION SETS. Harris, D. R.; Young, P. G.; Hale, G. M. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 323(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14699 ETOG-3 AND ETOT-3, ADVANCES IN PROCESSING ENDF/B-III LIBRARIES. Raymund, M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 323-325(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14700 EFFICIENT REPRESENTATION OF ENDF/B ANGULAR DISTRIBUTIONS IN MULTIGROUP PROCESSING CODES. Soran, P. D.; Weisbin, C. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 325-326(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14701 FINE-STRUCTURE EFFECTS IN MULTIGROUP REACTIVITY CALCULATIONS AND THE CENTRAL WORTH DISCREPANCY. Greenspan, E. (Princeton Univ., NJ). Trans. Amer. Nucl. Soc.; 16: 327-328(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14702 MULTILEVEL EFFECTS IN THE UNRESOLVED RESONANCE REGION. de Saussure, G.; Perez, R. B. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 16: 328-329(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14703 EFFECT OF SPACE-DEPENDENT FISSION MATRICES IN TRANSPORT CALCULATIONS. Hill, T. R.; Lathrop, K. D.; Hansen, G. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 16: 329-330(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14704 VARIATIONAL ESTIMATES IN CRITICAL REACTORS. Stacey, W. M. Jr. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 342(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14705 SECOND-ORDER PERTURBATION THEORY AND ITS APPLICATION TO SENSITIVITY STUDIES IN SHIELD DESIGN CALCULATIONS. Gerstl, S. A. W. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 342-343(Jun 1973).
From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14706 ROLE OF REACTOR PHYSICS IN THE DESIGN AND OPERATION OF POWER REACTORS. Critoph, E. (Chalk River Nuclear Labs., Ont.). pp 1-14 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordaov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
Topics discussed include the scope of reactor physics, the interaction of reactor physics with other disciplines, the engineering point of view, the research point of view, and compatibility and conflict between the two points of view. (JWR)

14707 SOME COMMENTS ON CRITICALITY CALCULATIONS IN THERMAL NEUTRON REACTORS. Edlund, M. C. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 15-46 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordaov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
The development of models for criticality calculations for thermal reactors is traced. An outline of the techniques currently in use includes a discussion of the general multigroup diffusion equations and their solution on digital computers. The calculation of group constants in the fast spectrum region with and without resonance absorption and thermal spectra is also discussed. Some comments are offered on the use of variational principles for calculating functionals which arise in three-dimensional flux synthesis problems and the use of the stationary functional as a Lagrangian for developing approximate theories. (JWR)

14708 REACTOR BURNUP PHYSICS. Tyror, J. G. (Atomic Energy Establishment Winfrith, Eng.). pp 47-93 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordaov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
The theoretical and experimental methods used in burnup physics calculations are reviewed. A wide range of burnup effects in various reactor types is discussed. (JWR)

14709 ANALYSIS OF REACTIVITY COEFFICIENTS FOR POWER REACTORS. Lunde, J. E. (OECD Halden Reactor Project, Halden, Norway). pp 95-133 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordaov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
After a brief introduction, sections are included on the representation of reactivity feedback effects, lattice calculations for void and temperature reactivity effects, and experimental methods and results. (JWR)

14710 REACTOR PHYSICS PROBLEMS CONCERNING THE STARTUP AND OPERATION OF POWER REACTORS. Blomberg, P. E. (Aktiebolaget Atomenergi, Stockholm, Sweden). pp 183-199 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordanov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
The gathering of physics data during the startup and initial operation of power reactors is discussed. Topics covered include fuel loading and initial criticality, reactivity measurements, shutdown margins, flux and power distributions, and in-core instrumentation. (JWR)

14711 FUEL MANAGEMENT IN POWER REACTORS. A Simplified Treatment of Reactivity and Reactivity Lifetime Transients Due to Fuel Management in Power Reactors. Lunde, J. E. (OECD Halden Reactor Project, Halden, Norway). pp 221-234 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordanov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
A simplified treatment of reactivity and reactivity lifetime transients caused by refueling is presented. The method is valid only for continuous or partial batch refueling that does not cause any macroscopic flux changes in the reactor system. (JWR)

14712 PHYSICS OF FAST POWER REACTORS. Storrer, F. (Centre d'Etudes Nucleaires de Cadarache, France). pp 247-291 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordanov, J. (ed.). Vienna; International Atomic Energy Agency (1973).
An introduction to fast reactor physics is presented. The characteristics and problems unique to fast reactor physics calculations are described. (JWR)

14713 NUCLEAR ENERGY. Gueron, J. Paris; Presses Universitaires (1973). 126p. (In French).
The chapters have the following titles: nuclei and nuclear reactions; the fission of nuclei and nuclear energy; the neutron; chain reactions and neutron multiplying media; neutron economics; experimental and industrial nuclear reactors; nuclear explosions, dangers, and radioprotection; developments in nuclear energy. (FR)

14714 (n,γn') REACTION IN CALCULATIONS OF FAST REACTOR NEUTRON SPECTRA. Fricke, M. P.; Neill, J. M. (Gulf Radiation Tech., San Diego, CA). Nucl. Sci. Eng.; 50: No. 4, 392-397(Apr 1973).
The neutron spectrum and criticality of ZPR-3 Assembly 11 were calculated using estimated cross sections for the $^{238}U(n,\gamma n')$ reaction. Inclusion of this reaction markedly improves agreement between the measured and calculated spectra, and it also decreases the calculated criticality by 0.62%. This change in criticality can be compensated for by lowering the ^{238}U capture cross section from the ENDF/B-III values to those of a recent microscopic measurement. These and other ramifications of the $(n,\gamma n')$ reaction in fast reactor assemblies are discussed. (auth)

14715 POSSIBILITIES AND LIMITS OF THE PREDICTION OF CORE PARAMETERS OF FAST REACTORS USING ZONE ASSEMBLIES IN CRITICAL FACILITIES. Helm, F. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German and English).
From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).
The determination of the multiplication factor k(eff), with measurements of the central Na-void coefficients, is discussed. By means of these examples, it is possible to reduce the uncertainties in the prediction of important neutron physical parameters concerning the SNR 300 by SNEAK experiments. (GE)

14716 CHARACTERISTIC QUANTITIES FOR THE OVERALL THERMAL AND HYDRAULIC DESIGN OF FAST REACTOR CORES. Doetschmann, K.; Ammendola, A. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

Following an explanation of the definition, requirements and methods of a total thermohydraulic design, a discussion on the characteristic quantities, friction coefficients and shock losses, heat transfer coefficients and transport quantities are given. The investigations are directed to the calculation of temperature distribution, maximum temperature and heat transfer for an optimum core design. (GE)

Reactor Components and Accessories

Refer also to abstracts 12821, 13110, 13115, 13127, 13168, 13211, 13241–13243, 13249, 13250, 13315, 13316, 13321, 13322, 13327–13333, 13353, 13357, and 14812.

14717 (EUR–4820(Vol.2)(Pt.C), pp 51–68) NUCLEAR STRUCTURAL GROWTH INDUCED BY RATCHETTING. Hibbeler, R. C. (Youngstown State Univ., OH). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The progressive growth of a structural material, subjected to a cyclic heat flux and sustaining a load, is called "thermal ratchetting". The increment of growth developed during each thermal cycle is caused by either plastic yielding or creep of the material. An investigation of this phenomenon is presented which applies to nuclear structural components in the form of thin cylindrical shells sustaining an internal pressure. Using different models to account for the stresses in the hoop direction, an analysis is presented which forms a useful basis for determining the allowable stress conditions necessary to prevent ratchetting. When ratchetting occurs, this analysis gives a prediction of the ratchetting growth during each thermal cycle. An exact method of analysis accounting for a triaxial stress condition in the material is also presented. The results using the simple models for representing the ratchetting behaviour are then compared with the exact analysis. (auth)

14718 (EUR–4820(Vol.2)(Pt.C), pp 89–106) VARIATIONAL PRINCIPLES OF CREEP MECHANICS WITH APPLICATIONS TO THE PROBLEM OF CREEP COLLAPSE OF FUEL ELEMENT CLADDINGS. Malmberg, T. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Two general variational principles are discussed, which are applicable to creep problems. They are formulated for small strains but finite rotations. The corresponding constitutive relations are: a nonelastic viscous solid (e.g. fully developed secondary creep), and a solid having simply additive elastic and creep strain rates. On the basis of these theorems several variational principles for thin shells are formulated assuming small strains but moderately large rotations. The theory is within the frame of the Kirchhoff-Love hypothesis. Using the Ritz method one principle is applied to the problem of creep collapse of a long fuel element cladding under external pressure. The temperature field is assumed to be rotationally as well as nonrotationally symmetric. (auth)

14719 (EUR–4820(Vol.2)(Pt.C), pp 107–122) STRESS DISTRIBUTION IN AXIALLY FINNED FUEL ROD CLADDINGS. Krieg, R. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The stresses in fuel element claddings are produced by fission gas, fuel and coolant pressures, differential thermal expansions, and possibly by irradiation induced differential swelling of the cladding material. The elastic stress distribution is well known and easily obtained in rotationally symmetric fuel element claddings. However the stress analysis of claddings having integrated fins in the axial direction needs a considerably larger effort; but such an investigation is necessary because of possible stress concentrations at the roots of the fins. A numerical method is presented which is based on Airy's stress function and suitable trigonometric series. The calculations indicate that this method gives good results for the stress distribution, if the root radius of the fins is not too small. (auth)

14720 (EUR–4820(Vol.2)(Pt.C), pp 123–144) BUCKLING OF A STRIP ON A RIGID HALF-SPACE WITH A TRANSVERSE PRESSURE: WRINKLING OF NONBONDED CLADDING. Anderson, W. F. (Liquid Metal Engineering Center, Canoga Park, CA). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The problem investigated is that of the stability of a uniform strip resting on a rigid half-space as a base while subjected to both a transverse force pressing it against the base, and an axial force or displacement. The system is shown to be completely imperfection-sensitive, with theoretically infinite buckling loads in the absence of imperfections. The behavior of the strip after buckling ensues is highly nonlinear. The effect of both sharp and smooth (cosine wave) imperfections is studied analytically. A numerical method is also developed for solution of the static buckling problem. Results of the analytical and numerical methods agree. The numerical method is used to obtain the static buckling load where the base has uniformly distributed imperfections of random magnitude. Forty-nine cases of buckling, with the base having random imperfections, are studied and a correlation is shown between the magnitude of the axial buckling force and the RMS value of the magnitude of the random imperfections. (auth)

14721 (EUR–4820(Vol.2)(Pt.C), pp 145–174) TEXTURE AND ANISOTROPY OF ZIRCONIUM IN RELATION TO PLASTIC DEFORMATION. Kaellstroem, K. (Sandvik Steel Works, Sandviken, Sweden). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Possible modes of plastic deformation of tubular materials are analyzed in a general, yet illustrative way. Based on symmetry considerations applied on known textures of zirconium wire and strip, textures of zirconium tubes are predicted as resulting from a wide range of deformation modes. This is made possible by focusing on the main feature of texture, i.e. the orientation distribution of basal poles in large. A relation between texture and the mechanical anisotropy of zirconium is developed, and rules are suggested for softening and hardening caused by texture change. Experimentally, zircaloy tubes were deformed by various techniques, in each case to a series of deformation degrees. The resulting texture was determined by x-ray diffraction and the mechanical anisotropy by Knoop-hardness measurement. Each determination is condensed into two representative figures, one describing the type of texture or anisotropy and the other describing the sharpness of texture or the degree of deviation from isotropy. The experiments verify the predicted relation between the type of texture and mechanical anisotropy, and also indicate how the degree of anisotropy depends on the sharpness of texture. Changes in texture are investigated in relation to the plastic deformation, and further refined rules are derived for the direction and rate of these changes. The initially predicted textures are concluded to be stable, i.e. they are reached only after a certain degree of deformation. Zircaloy tubes of three separate textures were subjected to tensile testing, closed-end burst testing, and open-end burst testing. The observed texture-softening phenomenon corroborates the rules suggested and is concluded to occur commonly, as opposed to texture hardening, which requires special combinations of texture and testing method. (auth)

14722 (EUR–4820(Vol.3)(Pt.E)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20–24 SEPTEMBER 1971. Vol. 3. Reactor Components. Part E. Shock and Vibration Analysis of Reactor Components. Jaeger, T. A. (comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 475p. (In several languages). (CONF-710903-(Vol.3)(Pt.E)). EUR.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

Twenty-four papers presented at the conference are included. A separate abstract was prepared for each of 23 papers. An abstract of one paper appeared previously in NSA as Abs. No. 25: 57070. (LCL)

For abstracts of individual papers see: 12801, 12802, 14308, 14329–14331, 14386, 14406–14408, 14583–14588, 14668, 14723, 14724, and 14821–14824.

14723 (EUR–4820(Vol.3)(Pt.E), pp 15–34) INFLUENCE OF FINITE DURATION PRESSURE PULSE ON THE TRANSIENT

RESPONSE OF ELASTIC-PLASTIC, STRAIN-RATE-SENSITIVE CYLINDRICAL AND SPHERICAL SHELLS. Duffey, T. A. (Sandia Labs., Albuquerque, NM). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Cylindrical and spherical shells, of interest as reactor containment vessels and piping, are subjected to uniform internal pressure pulse loadings that are rectangular in time and of large magnitude. The structures analyzed are constructed of elastic-plastic materials including strain hardening and linear strain rate sensitivity. It is assumed for the cylindrical shell that all points in the reference surface undergo uniform radial motion, and, for the spherical shell, that motion is spherically symmetric. The solutions, obtained in terms of elementary functions, are utilized to investigate the influence of the pressure pulse duration on the dynamic response of the structures considered. It is shown that, for a given pulse duration, peak deflections are more highly influenced by material strain rate sensitivity as the impulse level is increased. Further, it is found that for a given total impulse, the influence of strain rate sensitivity on peak deflections continually decreases as the pulse duration increases. (auth)

14724 (EUR-4820(Vol.3)(Pt.E), pp 75-86) TRANSIENT RESPONSE OF LINEAR ELASTIC STRUCTURES DETERMINED BY THE MATRIX EXPONENTIAL METHOD. Stoddart, W. C. T. (Oak Ridge National Lab., TN). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Determination of the response of components of nuclear power plants to transient inputs is a frequent problem. For many components, response must be limited to linear elastic behavior. The matrix exponential algorithm has been used to determine the response of systems which may be modeled as plane frames in combination with lumped masses and weightless springs. A comparison of the response calculated for simple systems by the matrix exponential method with that determined by modal analysis methods is made. (auth)

14725 (EUR-4820(Vol.3)(Pt.F)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 3. Reactor Components. Part F. Structural Analysis of Core Support and Coolant Circuit Structures. Jaeger, T. A. (comp.). (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 516p. (In Several Languages). (CONF-710903-(Vol.3)(Pt.F)). EUR.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

Information is presented concerning the structural analysis of reactor core support structures, structural analysis of miscellaneous reactor components, and structural analysis of coolant circuit components. Separate abstracts are included for 26 of the 27 complete papers presented. One of the papers has been previously abstracted and included in NSA. (DCC)

For abstracts of individual papers see: 14332-14334, 14365-14367, 14387, 14388, 14409-14412, 14471, 14589-14591, 14726-14734, and 14825.

14726 (EUR-4820(Vol.3)(Pt.F), pp.129-143) DYNAMIC ANALYSIS OF A NOVEL REACTOR HEAD PLATE DESIGN. Krajcinovic, D. (Argonne National Lab., IL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Presented is a simple, approximate dynamic analysis of a sandwich type pressure vessel head plate with a significant energy absorbing potential. The analysis is based on the propagation of a compression (shock) front through the middle layer made of crushable material. (13 references) (auth)

14727 (EUR-4820(Vol.3)(Pt.F), pp 205-216) ELASTIC INSTABILITY OF EDGE-REINFORCED ANNULAR PLATES. Widera, O. E.; Amon, R. (Univ. of Illinois, Chicago). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The problem of the instability of an edge-reinforced annular plate subjected to uniform pressure loads at its boundaries is studied. Only the axial symmetric buckling mode is considered. The reinforcement consists of beams whose width is small compared to their radii so that they may be treated by use of an elementary theory. The fact that each of the beams and the plate may possess different elastic and geometric properties is included in the analysis. By varying the properties of the beams, the complete range of reinforcing (zero to infinitely stiff) can be represented. A variety of separate practical problems can thus be obtained as special cases of the analysis. (12 references) (auth)

14728 (EUR-4820(Vol.3)(Pt.F), pp 217-233) PHOTOTHERMOELASTIC AND THEORETICAL ANALYSIS OF STRESSES IN A CIRCULAR DISC HAVING A PAIR OF HOLES. Atsumi, A.; Hata, T.; Kuraschige, M.; Ito, S. (Tohoku Univ., Sendai). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin Federal Republic of Germany (20 Sep 1971).

A test method developed for two-dimensional photoelastic studies of steady-state thermal stresses is presented. Its use is described in a study of stress concentration in a circular disc having a pair of holes. The model is of composite construction, containing a built-in polariscope, and the measuring part is subjected to an almost uniform temperature along its longitudinal axis. Stresses are given by isoclinic and isochromatic lines. A method of theoretical analysis of the stresses is also presented. The numerical results for the particular case in the theoretical analysis are shown and compared with the experimental ones. (16 references) (auth)

14729 (EUR-4820(Vol.3)(Pt.F), pp 269-288) PLASTIC STRAIN ANALYSIS OF HEAT EXCHANGER TUBESHEETS. Giesecke, H. (MPR Associates, Inc., Washington, DC); Nichols, J. C.; Lohmeier, A. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A plastic strain analysis technique has been devised for application to a common heat exchanger configuration—a tubesheet connected at its outer periphery to a spherical shell on one side and a cylindrical shell on the other. The technique is based on shell theory and interaction analysis with appropriate modifications in the plastic regions of the structure. Simplified yield conditions developed by Hodge for sandwich plates and shells of perfectly elastic-perfectly plastic material are applied and solutions yield tube-sheet and shell strains and deflections over the applied pressure path as well as the limiting pressure of the structure. Due to scarcity of applicable experimental results of strains and deflections of vessels containing flat plates welded to spherical and/or cylindrical shells under pressure, a fully instrumental steel model was constructed and pressurized well into the plastic region while deflections and strains were recorded. Analysis results were compared to the model test results and found in good agreement. (4 references) (auth)

14730 (EUR-4820(Vol. 3)(Pt. F), pp 289-305) ANALYSIS FOR PIPEWORK SYSTEMS UNDER CREEP CONDITIONS. Spence, J. (Univ. of Strathclyde, Glasgow). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An analysis is presented for uniplanar systems including the effect of straight and curved portions, based on a simple creep constitutive relationship. It is demonstrated that the bends have a governing role in the relaxation characteristics of a system and their neglect leads to results which are grossly conservative. Some simplifications are proposed and more involved situations are discussed. 7 references. (auth)

14731 (EUR-4820(Vol. 3)(Pt. F), pp 307-320) DESIGN OF EXPANSION BELLOWS AND CALCULATION BY THE COLLOCATION METHOD. Danckert, H. (Volkswagenwerk, Wolfsburg, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The differential equations of a thin-walled axisymmetric shell may be represented by four sets of equations to be solved in turn. The numerical solution is obtained by applying the collocation method to achieve very accurate, finite differences. Singularities are handled in a simple and accurate manner. The method is applied to calculate an expansion bellows which is determined through a trigonometric function for the curvature of the meridian. 4 references. (auth)

14732 (EUR-4820(Vol. 3)(Pt. F), pp 321-337) LIMIT PRESSURE OF BRANCH-PIPE TEE CONNECTION. Ellyin, F. (Univ., Sherbrooke, Quebec). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The lower bound to the limit pressure of a branch-pipe tee connection is calculated on the basis of two widely used approximate yield surfaces. No exact bounds are available for one of the yield loci. The analysis performed enables one to set a bound to this yield surface. The limit pressure calculations are based on a non-linear programming code (SUMT), and have been computed for a wide range of geometric parameters. 13 references. (auth)

14733 (EUR-4820(Vol. 3)(Pt. F), pp 439-458) STRESS ANALYSIS OF B 16.9 TEES BY THE FINITE ELEMENT METHOD. Clough, R. W.; Powell, G. H.; Gantayat, A. N. (Univ. of California, Berkeley). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Progress toward the development of a digital computer program specifically designed for the stress analysis of forged piping tees used in nuclear reactor systems is described. On the basis of numerical experiments, a modified 8 node isoparametric solid element is selected for use in the program. A method of automatically generating an appropriate finite element mesh from a minimum of geometric data measured from the tee is described. Excellent agreement between computed and experimentally measured stresses is demonstrated for a test case. 11 references. (auth)

14734 (EUR-4820(Vol. 3)(Pt. F), pp 477-496) THERMAL STRESS ANALYSIS IN A GLOBE VALVE. Sonnemann, G. (Raytheon Data Systems Co., Norwood, MA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The thermal stresses in a torus, which approximates a globe valve configuration, are analyzed. The solution is carried out by considering the temperature distribution in toroidal, cylindrical, and ring coordinates. A complete solution is carried out for the ring coordinates including an internal temperature transient. By application of the finite integral transform theory, the temperature is evaluated. Then the thermal moment is obtained since it appears in the thermal stress equation. Comparison with the cylindrical pipe reveals that for the stresses at the inner boundary and for 45 degrees along the ring, the stresses are increased by the curvature effect. 2 references. (auth)

14735 (EUR-4820(Vol.4)(Pt.G)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 4. Reactor Pressure Vessels. Part G. Steel Pressure Vessels. Jaeger, T. A (comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 568p. (In several languages). (CONF-710903-(Vol. 4)(Pt.G)). EUR.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F.R. Germany) (20 Sep 1971).

Information concerning reactor pressure vessels is presented under the following headings: stress analysis of steel shells of revolution; stress analysis of steel shell intersections; stress analysis of steel vessel flanges; materials behavior during fracture of steel pressure vessels; methods of analysis for fracture of steel pressure vessels; and crack detection measurements. Separate abstracts are included for each of the 30 complete papers presented. (DCC)

For abstracts of individual papers see: 14309, 14335, and 14736-14763.

14736 (EUR-4820(Vol.4)(Pt.G), pp 1-15) STRESS ANALYSIS OF REACTOR PRESSURE VESSELS. Jezussek, A. (Siemens AG, Erlangen, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A general scheme is presented of a complete calculation of nuclear pressure vessels with the following items: geometric data including structural demands, properties of materials, loads, design, distribution of temperature, thermal and mechanical analysis (displacements and forces), stress calculation, and special stress analysis. The loads (i.e., pressure, temperature, weight, external forces, seismic forces, vibration, radiation, etc.) have to be specified for: design conditions, test conditions, normal and upset conditions (steady state and transient), emergency conditions, and faulted conditions. 8 references. (auth)

14737 (EUR-4820(Vol.4)(Pt.G), pp 17-35) THERMAL AND MECHANICAL STRESSES IN NUCLEAR REACTOR VESSELS. Hoffmann, R. E.; Ariman, T. (Univ. of Notre Dame, IN). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The stress and deformation analysis is presented for a finite circular cylindrical, thin, elastic shell of constant thickness which represents a nuclear reactor vessel. The shell has an insulated cutout of arbitrary shape on its lateral surface and it is subjected to a stationary heat flow and various mechanical loads. 20 references. (auth)

14738 (EUR-4820(Vol.4)(Pt.G), pp 37-48) ANALYSIS OF MODERATELY THICK SHELLS OF REVOLUTION. Goldberg, J. E.; Baluch, M. H.; Tang, Y. K. (Purdue Univ., Lafayette, IN). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A method is presented for the analysis of moderately thick shells of revolution under symmetrical loads. Using assumed transverse distributions of stresses and displacements, the governing differential equations are derived by a variational process. These equations are integrated numerically using a procedure developed previously. An example is included and provides an indication of the accuracy of the theory and the procedure. 9 references. (auth)

14739 (EUR-4820(Vol.4)(Pt.G), pp 49-63) APPLICATION OF THE FINITE ELEMENT METHOD TO THE CALCULATION OF REACTOR PRESSURE VESSELS. Bazant, E. (Technischer Ueberwachungs-Verein e. V., Cologne); Neubrech, G. E. Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

After a short review on the finite element method the application of the method is shown on two examples: a nozzle in a reactor pressure vessel and a circumferential crack in the pressure vessel wall. The basic theory of the finite element method is not presented in detail but in a more general manner in order to make clear the essential difference to the traditional application of theory of elasticity. 6 references. (auth)

14740 (EUR-4820(Vol.4)(Pt.G), pp 65-91) PLASTIC STRESSES AND STRAINS IN CYLINDRICAL REACTOR PRESSURE VESSELS. Ma, B. M. (Iowa State Univ., Ames). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Thermoplastic stresses, pressure plastic stresses and creep stresses produced (by constant elevated temperature, high internal pressure and intensive irradiation) in a long, cylindrical pressure vessel of a nuclear power reactor are determined analytically. Equations of stress, strain, and strain rate are derived based on the assumptions of isotropic, homogeneous, and incompressible material; state of plane strain, large plastic (or creep) strain, the distortion energy theory; and the constant ratio of principal shear stress rates to principal shear stresses. The transient thermoplastic stresses, steady pressure plastic stresses, and creep stresses, strains, and strain rates for power function creep law and exponential function creep law are evaluated from a numerical example. The computed results for the reactor pressure vessel are shown by curves. A rational safety design for pressure vessels of nuclear power reactors is briefly introduced. 8 references. (auth)

14741 (EUR-4820(Vol.4)(Pt.G), pp 92-103) STRESSES AND SHIFT VELOCITIES IN PLASTIFIED ZONES: ROTATIONALLY SYMMETRIC STRESSES WITH APPLICATION IN REACTOR CONSTRUCTION. Telkamp, T. (Siemens AG, Erlangen, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

For the theoretical investigation the well known equations of the mathematical theory of plasticity from LEVY-MISES will be used, especially the fundamental equations for axially symmetric stresses and plastic deformations. For the analysis of the stress field the equations of equilibrium and the yield criterion of MISES are increased by a condition, which is based on the stress-strain velocity-relations, because the problem is not statically determined. The solution of these equations bases on the theory of characteristics. The obtained theoretical results are used for the investigation of stresses in materials under bolted connections. It may be demonstrated, that the forces obtained by this method are much greater than those obtained by conventional methods. 4 references. (auth)

14742 (EUR-4820(Vol.4)(Pt.G), pp 105-117) DETERMINATION BY APPROXIMATION OF DEFORMATIONS AND STRESSES IN PERFORATED SHELLS OF REVOLUTION. Coenen, H.; Lehrke, H. P.; Jorde, J. (Fried-Krupp GmbH, Essen). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The closures of pressure vessels frequently incorporate extensive areas with nozzles. They can be regarded as perforated shells of revolution. Since the stress distribution in a shell influenced by several holes cannot be calculated analytically, unperforated shells with the same global elastic behavior are studied. The global stress distribution and the deformation under a given load are similar both for the perforated as well as for the unperforated equivalent shell. The stresses and deformations are computed for an edge loaded shallow spherical shell with a symmetric set of holes. The results are compared with measured values. 4 references. (auth)

14743 (EUR-4820(Vol.4)(Pt.G), pp 123-136) STRESS DISTRIBUTIONS IN THIN-WALLED INTERSECTING CYLINDRICAL SHELLS SUBJECTED TO INTERNAL PRESSURE AND IN-PLANE FORCE. Ando, Y.; Yagawa, G.; Kikuchi, F. (Tokyo Univ.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Stress analysis has been made with the application of the finite element method for the cases where the branch and the main pipes with nearly equal radii intersect at the angle of not only 90° but also 60° and 30°. Here, the considered loads are the internal pressure or the in-plane force applied at the end of the branch pipe. The hellinger-Reissner's variational functional was derived for the Novoshilov's and Mushtari-Vlasov shell theory. Further, considering the curvature as infinity in case of the above mentioned theories the element matrix was determined for the flat plate element which was derived by Herrmann. Comparison was made between the computed values and the results of the experiment which was carried out for steel models. 7 references. (auth)

14744 (EUR-4820(Vol.4)(Pt.G), pp 137-152) STABILITY ANALYSIS TO ESTABLISH THE DIMENSIONS OF NOZZLES IN REACTOR PRESSURE VESSELS. Engelke, V.; Ernst, Y.; Polesnik, W. (AEG-Telefunken, Frankfurt am Main). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A free body method to establish the dimensions of nozzles in reactor pressure vessels is described. The shape of the nozzle is approximated by short, thick walled cylinders, the connecting part between the nozzle and the vessel by a ring and the shell of the vessel by a plate. The two-dimensional stress distribution in the cylinder shell is replaced by a Fourier series. The load is comprised of the pressure, an axial force on the nozzle and strain caused by temperature distribution. The results compare well with those of the finite element method and measurements. 11 references. (auth)

14745 (EUR-4820(Vol.4)(Pt.G), pp 153-172) NOZZLE-TO-FLAT PLATE APPROACH IN THE STRESS CONCENTRATION PROBLEM OF NOZZLE-TO-CYLINDER INTERSECTIONS. van Campen, D. H. (Delft Univ. of Tech., Netherlands); Kroon, J. P.; Koopman, R. B. C.; Latzko, D. G. H. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An experimental verification is given of the nozzle-to-flat plate approach in the stress concentration problem of nozzle-to-cylinder intersections at d/D ratios $\leq \infty$ 0.15. The experimental flat plate results have been compared with experimental data of identical nozzles on a pressure vessel on one hand and the results of a finite element computation program for solids of revolution under non-axisymmetric loads on the other hand. The foundations underlying the computer program are summarized, while a generalization to the nozzle-to-cylindrical vessel problem is briefly described. (13 references) (auth)

14746 (EUR-4820(Vol.4)(Pt.G), pp 173-192) EXPERIMENTAL ELASTIC STRESS ANALYSES OF CYLINDER-TO-CYLINDER SHELL MODELS AND COMPARISONS WITH THEORETICAL PREDICTIONS. Corum, J. M.; Greenstreet, W. L. (Oak Ridge National Lab., TN). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Two carefully machined cylinder-to-cylinder shell models were tested, and the experimentally determined stresses were compared with theoretical predictions obtained from a thin-shell finite element analysis. The models were idealized structures consisting of two circular cylindrical shells intersecting at right angles. The first model tested had a nozzle-to-cylinder diameter ratio of 0.5 and a diameter-to-thickness ratio of 100 for both nozzle and cylinder. The second model had a nozzle-to-cylinder diameter ratio of 0.129. The diameter-to-thickness ratio was 50 for the cylinder and 7.68 for the nozzle. Both models were strain gaged and subjected to 13 separate loading cases. Comparisons of measured and predicted stress distributions are presented for three of these loadings—internal pressure and in-plane and out-of-plane moments applied to the nozzles. The analytical predictions were obtained using a finite element program that used flat-plate elements and which considered five degrees of freedom per node in the final assembled equations. The agreement between these particular finite element predictions and the experimental results is shown to be reasonably good for both models. (6 references) (auth)

14747 (EUR-4820(Vol.4)(Pt.G), pp 193-213) THREE DIMENSIONAL ANALYSIS OF REACTOR PRESSURE VESSEL NOZZLES. Rashid, Y. R.; Gilman, J. D. (General Electric Co., San Jose, CA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Crack analysis requires a high degree of accuracy which is not always obtained in three dimensional finite element analysis due to limitations on the mesh density. Two types of finite element idealizations are considered: the first is based on the linear displacement tetrahedron, and the second utilizes the incomplete cubic polynomial tetrahedron discussed. In both models the resulting system of equations exceeds 12,000 and 1,000 in size and bandwidth respectively. The method of solution is the alternating component iterative method which is described. Relative merits of both analyses are discussed with reference to degree of accuracy, running time, cost, input data preparation and interpretation of the analysis results. A study of the behavior of cracked nozzles is made by investigating postulated corner cracks of infinitely sharp circular boundaries. Several crack sizes are analyzed from which the critical size at the onset of unstable crack propagation or the rate of stable fatigue crack propagation in a given nozzle geometry is predicted. (8 references) (auth)

14748 (EUR-4820(Vol.4)(Pt.G), pp 215-237) THREE DIMENSIONAL FINITE ELEMENT ANALYSIS OF THICK-WALLED PIPE-NOZZLE JUNCTIONS WITH CURVED TRANSITIONS. Krishnamurthy, N. (Auburn Univ., AL). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The stress distribution at the junctions of thick-walled pressure vessels and pipes is of considerable theoretical and practical importance in nuclear reactor technology. The three-dimensional finite element analysis of a typical cylindrical-vessel-nozzle junction is presented. Mathematical relationships are developed defining the geometry of the surface and interior points of thick-walled vessel-nozzle junctions with curved transitions. The computer program developed for the automatic generation of cylindrical coordinates for the three-dimensional idealization of the junction is described. The principal features of the finite element computer program used for the three-dimensional stress analysis are presented. The application of the programs to idealize and analyze a typical vessel-nozzle junction for three mesh sizes is outlined, and the results are discussed. A stress concentration factor is evaluated for the problem studied. The study demonstrates the feasibility of three-dimensional finite element idealization and analysis of heavy-section vessel-nozzle junctions, and the general applicability to further investigations. The results indicate a region of high stress concentration in the transition region on the inner surface of the junction at the longitudinal section. (4 references) (auth)

14749 (EUR-4820(Vol.4)(Pt.G), pp 239-256) SIMPLE FINITE METHOD FOR STRESS CONCENTRATION PROBLEMS IN PRESSURE VESSELS. Giencke, E. (Technische Univ., Berlin). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The application of a simple finite method for solving stress concentration problems in pressure vessels is shown. In contrast to the finite element method, stresses and not deformations or stress functions will be introduced as unknowns. Thus the loss of accuracy by deriving the stresses from the deformations and stress

functions will be avoided. Equilibrium and compatibility can be satisfied by the principles of virtual work. By introducing special virtual displacements and forces only line integral must be solved. Therefore it is possible to utilize special approximations for the stresses near the stress concentration points for reducing the number of unknowns without loss of accuracy. Some examples as perforated plates and shells, and intersections of tubes with perforated plates and shells are discussed. (6 references) (auth)

14750 (EUR-4820(Vol.4)(Pt.G), pp 257-279) ELASTIC ANALYSIS OF AXIALLY PERFORATED CYLINDERS WITH APPLICATIONS TO THE DESIGN OF REACTOR VESSEL FLANGES. Bickell, M. B.; Dance, S. H. (Babcock and Wilcox Ltd., London). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The stress analysis of bolted closures for reactor pressure vessels requires an allowance to be made for the loss of stiffness in the flange ring due to the presence of the bolt holes. A method of dealing with this problem, based on the elastic stress analysis of an axially perforated cylinder, is described. The results of the application of the analysis to a typical reactor pressure vessel flange is compared with a simple calculation using a reduced Young's Modulus based on the loss of ring stiffness of the perforated flange. (7 references) (auth)

14751 (EUR-4820(Vol.4)(Pt.G), pp 281-293) BEHAVIOR OF PERFORATED FLANGES UNDER LOAD CONDITION SET UP BY EQUIDISTANT UPTURNING MOMENTS. Baumgart, F.; Dietze, R.; Jorde, J. (Fried-Krupp GmbH, Essen). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The flange is an important component of pressure vessels. The major load acting on the flange is set up by concentrated and distributed moments directed tangentially (upturning moments). The main deformation occurring under such loading is the rotation of the cross sections around the ring tangent (upturning angle). With rotational symmetry the upturning angle can easily be calculated. If the ring is weakened by bolt holes, it is shown that the relatively coarse approximation of the multiply connected area by a framework of curved structural members gives a compact expression for the upturning angle. It is calculated by the force method, the holes being replaced by surrounded annular sector pieces. The values obtained by measurements for different ring cross sections and hole diameters are in good agreement with the computed values, considering the degree of accuracy required in actual practice. The test setup enables circular rings of steel to be exposed to upturning concentrated moments acting on 30 points along the circumference by a gas-bufferred hydraulic system. The forces proportional to the concentrated moments are measured by mechanical dynamometers; the deformation of the circular ring is measured at its vertical outer flank by precision gauges. (auth)

14752 (EUR-4820(Vol.4)(Pt.G), pp 327-346) REQUIREMENTS FOR CONSIDERATION OF FRACTURE EXTENSION RESISTANCE PARAMETERS IN FRACTURE-SAFE DESIGN INVOLVING NONFRANGIBLE METALS. Loss, F. J.; Pellini, W. S. (Naval Research Lab., Washington, DC). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A case is presented to redirect the current emphasis on frangible behavior in fracture research to consider the nonfrangible metals that comprise the majority of engineering applications. Fracture-safe design (FSD) principles for structures using these materials can be evolved only through a procedure which integrates a fracture extension resistance property of the metal with the fracture extension propelling force that is unique to a given structural configuration. The approach described characterizes the material toughness in terms of a fracture extension resistance parameter, or R-curve, that is based on modified dynamic tear specimens. Interpretation of the R-curve to the performance of a flawed structural prototype can be assessed in terms of an Instability Analysis Diagram (IAD) which incorporates the results of structural element prototype tests that exhibit the dominant fracture extension characteristics of the prototype. (13 references) (auth)

14753 (EUR-4820(Vol.4)(Pt.G), pp 367-377) INFLUENCE OF STRESS FREE ANNEALING ON MECHANICAL PROPERTIES OF PRESSURE VESSEL STEELS. Fuchs, A.; Detert, K. (AEG Telefunken, Frankfurt am Main). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Stress relief cracking of welded structures was studied. It can be regarded as a kind of non ductile stress rupture cracking in a matrix, heat affected by the weld. It is caused by reprecipitation of carbides, which had been desolved in the heat affected zone. In steels investigated with vanadium content in excess of 0.1 weight percent, a substantial decrease of ductility in a creep test within a few minutes at 600°C is observed. Only in those steels a reduced ductility was measured of a heat affected matrix, annealed for about one hour at 600°C. A special sensitivity towards fracture therefore exists only in steels investigated with vanadium content in excess of 0.1%. (6 references) (auth)

14754 (EUR-4820(Vol.4)(Pt.G), pp 379-388) PREDICTION OF RADIATION-INDUCED CHANGES IN FRACTURE TOUGHNESS K_{Ic} FROM SMALL SPECIMEN TESTS. Wullaert, R. A. (Effects Tech., Inc., Santa Barbara, CA); Ireland, D. R.; Tetelman, A. S. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A model has been developed for predicting the radiation-induced changes in the macroscopic measure of fracture toughness (K_{Ic} or K_{Id}) from changes in the microscopic or metallurgical fracture parameters σ_y (yield strength), σ_f^* (microcleavage fracture strength) and ρ_θ (critical crack tip radius). Two different methods have been devised to determine these microscopic parameters from small specimen(Charpy V) tests. The model has been applied to the results of a typical nuclear pressure vessel surveillance program on A302B steel. The standard surveillance program provided Charpy energy curves and static fracture toughness for both the unirradiated and irradiated steel. An instrumented Charpy machine was used to obtain dynamic notched bend and fracture toughness data. The implication of the study is that the standard Charpy V specimens available in reactor surveillance programs can be used to predict the dynamic fracture toughness behavior of irradiated pressure vessel steels. (6 references) (auth)

14755 (EUR-4820(Vol.4)(Pt.G), pp 389-401) DYNAMIC FRACTURE MECHANICS APPROACH IN REACTOR VESSEL SURVEILLANCE. Venzi, S.; Erra, A.; Rossi, F. (Centro Sperimentale Metallurgico, Rome). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The introduction of the F.M. approach in nuclear pressure vessel surveillance programs entails a greater complexity in the execution of the tests. Instrumented impact tests allow the rapid and simple determination of a large mass of data, which may be analyzed in terms of F.M. They are thus suitable for the determination of the characteristics of a material before and after irradiation. The test is examined with particular reference to the dynamic determination of C.O.D. and K_{IC}. The philosophy of the test is described, and the possibility is considered of the correlation of F.M. results on heavy sections of non-irradiated material with those obtained dynamically on small specimens of irradiated materials. The results presented refer to 100 mm plate of Mn, Mo pressure vessel steel. (13 references) (auth)

14756 (EUR-4820(Vol.4)(Pt.G), pp 405-423) PROCEDURES FOR INTERPRETING THE STRUCTURAL SIGNIFICANCE OF RADIATION DAMAGE SURVEILLANCE RESULTS. Steele, L. E.; Serpan, C. Z. Jr. (Naval Research Lab., Washington, DC). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The structural implications of radiation effects to nuclear pressure vessels are assessed primarily through surveillance programs in which the properties of the vessel are projected from an evaluation of small specimens of the vessel steel. In the U. S. the current fracture-safe criterion requires that the vessel operating temperature, while under certain stress levels, be at the FTE (Fracture Tansition Elastic) temperature defined as NDT + 60°F (33°C) as derived from surveillance measurements. Review of available data from five reactor surveillance programs indicates that this criterion is adequate for the vessels concerned. Complete assurance of fracture-safe operating conditions can be attained through a limit-analysis procedure that considers and integrates the effects of five factors: the radiation-induced shift in transition temperature; the initial shelf energy; the radiation-reduced ductile shelf energy; the effects of fluence (and toughness) gradient through a thick-vessel wall; and the effects of thickness-induced mechanical constraint. (22 references) (auth)

14757 (EUR-4820(Vol.4)(Pt.G), pp 425-438) STRESS AND STRAIN DISTRIBUTION AROUND CRACKS IN COMPLEX PRES-

SURE VESSEL CONFIGURATIONS. Ruiz, C. (Oxford Univ.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The determination of the stress distribution around cracks in the immediate vicinity of nozzle-to-shell junctions is analyzed. A technique is described for the measurement of the stress intensification factor, based on the use of a photoelastic layer sandwiched within an optically inert model. The relevance of the value thus found for the characterization of the severity of the crack is finally discussed. (8 references) (auth)

14758 (EUR-4820(Vol.4)(Pt.G), pp 440-467) FRACTURE OF CRACKED PRESSURE VESSELS. Costes, D.; Dore, A. (CEN de Saclay, Gif-sur-Yvette, France). Mar 1972. (In French).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Safe behavior of pressure components must be assessed through a notch sensitivity analysis. The established theories apply only to low toughness materials (Linear Elastic Fracture Mechanics or L.E.F.M.) and to very ductile materials (Similitude). The materials used in heavy construction and in atomic energy field are intermediate between brittle and ductile and require an intermediate analysis. The present approach starts from similitude, using a non-dimensional diagram with a geometry parameter and a stress parameter. A notch sensitivity parameter is derived, which associates brittleness and plasticity terms. The analysis uses published results on notched vessels and new CEA results; tests with plain cracks and sliding patches and tests with 20% remaining ligament cracks are found in general agreement and give the bulk of correlations. (17 references) (auth)

14759 (EUR-4820(Vol.4)(Pt.G), pp 469-485) FRACTURE STUDIES OF MODEL PRESSURE VESSELS MADE OF NUCLEAR GRADE STEEL. Derby, R. W. (Oak Ridge National Lab., TN). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Two series of flawed, thick-walled, model pressure vessels were tested to destruction. The temperature range investigated was between -50°F and 215°F. The tests revealed a marked change in behavior within a narrow temperature interval. The burst pressure of the vessels was not greatly reduced by the presence of a relatively large sharp flaw. Both pneumatic and hydraulic loading were used. (8 references) (auth)

14760 (EUR-4820(Vol.4)(Pt.G), pp 487-505) INTENSITY FACTORS OF STATIONARY CRACKS IN CYLINDRICAL SHELLS UNDER INTERNAL PRESSURE. Theocaris, P. S. (Athens National Technical Univ.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An optical method was developed for the study of the constrained zones surrounding the crack tips in models of cracked cylindrical shells made of transparent and optically inert materials, subjected to internal pressure. According to this method, partial reflection of a light beam from the back surface at the vicinity of the crack tip impinging normally to this area deviated at the constrained zone and formed a caustic. It was shown that for an elastically deformed shell the caustic formed a generalized epicycloid when it was projected on a screen at some distance from the crack. The characteristic properties of this epicycloid and their interrelation to the stress intensity factor k_s of the cracked shell were examined for the case of a circumferential single crack. Experimental evidence with plexiglas shell models under internal pressure corroborated with the theoretical results. (12 references) (auth)

14761 (EUR-4820(Vol.4)(Pt.G), pp 507-527) ACOUSTIC EMISSION ANALYSIS OF CRACK PROPAGATION AND FRACTURE IN PRESSURE VESSELS AND PRESSURE VESSEL MATERIALS. Green, A. T.; Dunegan, H. L. (Dunegan Research Corp., Livermore, CA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The acoustic emission data generated and recorded during metal tensile specimen tests, both unflawed and flawed, model concrete pressure vessel tests, and compressive tests of cylindrical specimens are presented. Irradiation, temperature, prestressing, and internal pressurization test results are discussed for the various specimens, as are other factors which affect the acoustic emission response of the material. Parametric relationships between acoustic emission data and other indices of structural performance is presented. (13 references) (auth)

14762 (EUR-4820(Vol.4)(Pt.G), pp 531-552) SURFACE CRACK TESTING OF REACTOR PRESSURE VESSELS. Fischdick, H. (AEG-Telefunken, Frankfurt am Main). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The importance of nondestructive testing of surface cracks on pressure vessels for atomic power generation in addition to the ultrasonic inspection is discussed. The various methods of detecting surface cracks are also discussed in comparison to its specified requirements, to measure length and depth of cracks and to the possibility of automatic functioning. The eddy current method appears to be the most suitable. The influence of distance between test coil and surface, the influence of crack shape, and an estimate of the sensitivity, accuracy and speed of the testing are described. (7 references) (auth)

14763 (EUR-4820(Vol.4)(Pt.G), pp 553-568 ACOUSTIC EMISSION INTEGRITY ANALYSIS OF PRESSURE VESSELS AND PIPING. Parry, D. L. (Jersey Nuclear Co., Richland, WA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Acoustic analysis tests of nuclear pressure vessels have resulted in the detection and accurate location of flaws and defect regions. The defect sites were cross-checked and confirmed using standard nondestructive test techniques. Tests conducted on pressure and drill piping have enabled the detection and location of material flaws, corrosion and leaks. (auth)

14764 (EUR-4820(Vol.4)(Pt.H)). PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 4. Reactor Pressure Vessels. Part H. Prestressed Concrete Pressure Vessels. Jaeger, T. A. (comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 752p. (In several languages). (CONF-710903-(Vol.4)(Pt.H)). EUR.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

Thirty-eight papers were presented. A separate abstract was prepared for each of 37. One paper was previously abstracted in NSA as Abstract No. 26:8555. (LCL)

For abstracts of individual papers see: 13355-13362, 14310, 14311, 14368-14377, 14389, and 14765-14780.

14765 (EUR-4820(Vol.4)(Pt.H), pp 5-22) TRIAXIAL STATE OF STRESS OF CONCRETE STRUCTURES. Janda, L. (Technical Univ., Prague). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Assessment of the state of stress and the safety margin against failure of triaxially stressed concrete structures is based on the surface of rupture, i.e. the stress failure envelope. According to test results, its form is not a body of revolution. For analytical purposes a simplified form is introduced suggested by Reimann which is compared with the form deduced from the tests carried out by Launay, Gachon et Poitevin. The application of Mohr's general theory according to Filonenko-Borodich makes it possible, in the meaning of Mohr's failure hypothesis, to discern whether concrete under the given type of stress fails in shear (similarly as in the case of plain compression) or in tension (similarly as in the case of plain tension). In the case of failure in tension reinforcement is designed to transfer the tension. In this process a graduation of the permissible safety margin values is recommended in accordance with whether the structure is of plain, reinforced or prestressed concrete. This method also makes it possible to theoretically follow the states of overloading the structure to the point of failure. (auth)

14766 (EUR-4820(Vol.4)(Pt.H), pp 23-40) STRAIN AND ULTIMATE STRENGTH OF CONCRETE UNDER TRIAXIAL STRESS. Launay, P. (Compagnie Industrielle de Travaux, Paris); Gachon, H. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Three years, including construction time for the test machine,

were spent measuring the deformation of concrete cubes (14 × 14 × 14 cm) under combined compression stresses up to 500 bars at temperatures of 20°C, 40°C and 60°C, and the ultimate strength of concrete cubes (7 × 7 × 7 cm) under combined compression stresses up to 2,000 bars and under two compression stresses and one tension stress. One type of concrete was investigated which had previously been thoroughly studied under uniaxial stress; creep and shrinkage properties were particularly investigated before this type was selected to be the concrete used in the construction of the prestressed concrete pressure vessel of nuclear reactor BUGEY I. Therefore instrumentation in situ should support the research made on specimens. The three different limits emphasized as important results of the triaxial stress effects investigation were: the "quasi-elastic" limit under which the concrete behaves as a purely elastic material; the crack initiation limit under which the concrete shows a much larger bearing capacity than when submitted to an uniaxial stress. (This limit can be detected by sonic tests on the test specimen); and the ultimate strength limit which corresponds to flow of the material, i.e. extended deformation without increase of stresses imposed. Corresponding curves are traced and an analytical approach is proposed. As a first result of these experiments, tentative criteria and increased permissible stresses might be obtained for concrete subjected to multiaxial compressive stresses. However, extreme care should be taken for the case in which tension is imposed in one direction while increasing the compression in the other two directions. (auth)

14767 (EUR-4820(Vol.4)(Pt.H), pp 167-186) TWO-DIMENSIONAL TIME-DEPENDENT ANALYSIS OF PERFORATED END CAPS FOR NUCLEAR REACTOR PRESSURE VESSELS BY THE FINITE-ELEMENT METHOD. Stefanou, G. D. (City Univ., London); Yu, C. W.; England, G. L. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The design of prestressed concrete pressure vessels for nuclear reactors, and in particular, the design of the end caps to the cylinders increasingly call for more sophisticated and better analytical techniques. A method is proposed for analyzing the mode of action of the end slabs, assuming constant elevated temperature and radial compression. These simplified assumptions represent reasonably realistic operating conditions. If required, more complex operating conditions can be incorporated. A special feature of the proposed analysis is the method by which an elastic solution can be modified to take account of the time-dependent effects such as creep and shrinkage at ambient and under elevated temperatures. The elastic solution is based on the two-dimensional finite element formulation using triangular plate elements. After obtaining the initial elastic state of stress, a complete elastic, thermoelastic and time-dependent solution is achieved in a step-by-step manner, based on the "Rate of Creep" approach, and using small time intervals during which the stresses are assumed constant. The technique was used to analyse slab models tested and reported elsewhere. It was shown that the proposed method estimates the deformational behaviour of the models with an acceptable degree of accuracy. The redistribution of stress as a result of thermal creep predicted by the method also agreed well with the cracking pattern of the models. It is also seen that the proposed method which is quite general, takes into account loading history. In addition, it has the advantage of economizing in computer time. (auth)

14768 (EUR-4820(Vol.4)(Pt.H), pp 187-230) BEHAVIOUR OF END SLABS IN CYLINDRICAL PRESTRESSED-CONCRETE PRESSURE VESSELS. Langan, D.; Garas, F. K. (Taylor Woodrow Construction Ltd., Southall, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The general behaviour and shear failure mechanism of restrained thick slabs which form the end closures of cylindrical Prestressed Concrete Pressure Vessels are examined. Typical results from a five year parametric study of over 20 model pilecaps are presented. The effects of bonded reinforcement, lined and unlined penetrations, span to depth ratio, concrete strength, level of hoop prestress and boundary conditions were investigated. The factors which may influence the representivity of end slab tests and the effect of the significant parameters on the overload and ultimate load behaviour of the full scale structures are discussed. Finally, the components of internal shear resistance which balance the total shear force along the failure plane are described. Simplified design methods for determining the ultimate shear strength of end slabs are considered and related to the available test data. (auth)

14769 (EUR-4820(Vol.4)(Pt.H), pp 231-251) THREE-DIMENSIONAL ANALYSIS OF THE NONLINEAR BEHAVIOR OF A PRESTRESSED-CONCRETE REACTOR PRESSURE VESSEL. Khan, M. H. (Bonnard and Gardel, S. A., Lausanne, Switzerland); Saugy, B.; Zimmermann, T. Mar 1972. (In French).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The method of three dimensional analysis of a non-linear behavior up to failure of massive structures of reinforced or prestressed concrete is first described briefly. The non-linear analysis is carried out by an iterative process in which the mechanical characteristics of the material are variable as a function of the state of stress up to failure, defined by an unsymmetrical surface in the coordinate system of principal stresses. After failure, the stress-strain law is modified to take into account the new internal structure of the material. To check this mathematical model of three dimensional nonlinear analysis a deep end slab of a PCRV was analyzed up to failure. The same slab was subjected to extensive laboratory tests by Prof. D. Campbell-Allen of the University of Sidney. The results of the non-linear analysis are compared with those obtained by the tests. This comparison includes the cracking pattern in function of the internal pressure, the deformation, and the final failure load of internal pressure. (auth)

14770 (EUR-4820(Vol.4)(Pt.H), pp 253-272) LOAD LIMIT ANALYSIS: COMBINATION OF STATISTICAL METHODS (MONTE CARLO METHOD) AND FINITE-ELEMENT METHOD FOR FRACTURE CALCULATIONS OF PRESTRESSED-CONCRETE REACTOR PRESSURE VESSELS. Hofmann, H. H. (SDK Ingenieurunternehmen fuer Spezielle Statik, Dynamik und Konstruktion, Loerrach, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The problems arising in failure analysis using three-dimensional finite element analysis are summarized. A different path is drawn to avoid some of these problems especially with regard to concrete structures. The problems can generally be subdivided into the following groups: physical representation; mathematical formulation; and computer techniques. The first group includes questions of material properties and failure criteria as well as engineering judgement. Besides the well-known difficulties a possible way is shown to find a mathematical model for the physical problem. This alternative way is a statistical analog (Monte Carlo Method). It is then tried to complete the lacking material properties and failure criteria using the statistical analog. Finally the problems occurring in computer techniques such as stability of the mathematical model are discussed. (auth)

14771 (EUR-4820(Vol.4)(Pt.H), pp 273-287) CALCULATIONS OF PRESTRESSED-CONCRETE REACTOR PRESSURE VESSELS CONSIDERING NONLINEAR STRESS-STRAIN LAWS APPLYING THE DYNAMIC RELAXATION METHOD. Schnellenbach, G. (Ruhr Univ., Bochum, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Three-dimensional calculations of prestressed concrete pressure vessels may not be restricted to the elastic case. Concrete properties depend on time and temperature. A vessel analysis with modern computation methods has to take account of the variable material behaviour. If stresses exceed the elastic range of concrete it may be necessary to perform an elasto-plastic calculation. In regions, where stresses exceed the tensile strength of concrete and where tensile stresses are carried mainly by the reinforcement, possibly a calculation considering cracking of concrete has to be performed. The dynamic relaxation method is a suitable method for three-dimensional calculations of prestressed concrete pressure vessels with the mentioned material behavior. The theory for elastic solutions with the dynamic relaxation method is well known. A description is given only as far as necessary to understand computation processes with constitutive laws different from linear elasticity. Some remarks are made on the computation of three-dimensional temperature distributions and the calculation of resulting stresses. Assumptions and the computation process for the creep calculation are outlined. An elasto-plastic calculation with the dynamic relaxation method is described with an example of a plane problem using a nonlinear constitutive law based on Prandtl-Reusz theory. Assumptions for calculations of prestressed concrete pressure vessels with cracked zones are outlined. (auth)

14772 (EUR-4820(Vol.4)(Pt.H), pp 289-313) CALCULATION OF TIME-DEPENDENT STRESSES IN PCPVs BY AN APPROXIMATE METHOD. England, G. L. (King's Coll., London); Allen, S. J. Mar 1972.

From 1st international conference on structural mechanics in

reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The calculation of time-varying stresses in materials subject to non-homogeneous creep is discussed. Economic solutions are sought using a general theory based on a power variational principle. This permits approximate solutions to the time-varying stresses, in real and complex structures, to be obtained with little effort from a minimum of input data. It is shown that conventional finite element stiffness analyses may be used to provide the necessary input data to the creep problem; these take the form of a set of independent stress distributions throughout the structure. Then, using a flexibility approach these stress distributions are optimized to achieve the best possible fit to the true solutions during the time-dependent phase of the problem. Finally, the theory is applied to two problems and solutions are presented for a thin plate subject to in-plane edge loading and non-uniform temperature distribution and a short cylindrical prestressed concrete reactor pressure vessel, with end caps, subjected to internal pressure and temperature crossfall through the walls and caps. (auth)

14773 (EUR-4820(Vol.4)(Pt.H), pp 413-435) PRESTRESSED-CONCRETE REACTOR PRESSURE VESSEL USING A HOT LINER. Nemet, J. (Reaktorbau Forschungs- und Baugesellschaft mbH and Co., Seibersdorf, Austria). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Prestressed concrete reactor vessels designed and built up to now have a cold steel liner and a thermal insulation covering the liner from inside and penetrated by the reactor coolant. Failures of the liner especially due to failures of the insulation cannot be easily detected and repaired. Inspections of the liner during the reactor lifetime desirable from safety considerations are not possible. To overcome this drawback a new reactor vessel concept has been designed based on the use of a hot liner in direct contact with the reactor coolant at core entrance temperature. The thermal insulation is placed between the liner and the prestressed concrete structure. Thus the liner is accessible for inspection and repair. In order to keep low the stress amplitude in the liner at each temperature cycle, the prestressed concrete structure is kept at an elevated temperature level. The hot liner concept leads to technological problems yet to be solved, e.g. temperature and stress cycling of the liner and elevated temperatures of the prestressed concrete. To explore these problems and to show the feasibility and reliability of the hot liner concept a large scale model vessel (internal pressure of 100 atm, liner temperature of 300°C) has been designed and built at the Reactor Centre Seibersdorf. The necessary preliminary investigations are covering the development of suitable concrete, insulation, liner materials, welding and anchoring procedures, and concrete instrumentation for elevated temperatures. (auth)

14774 (EUR-4820(Vol.4)(Pt.H), pp 437-461) DESIGN AND CALCULATION OF CYLINDRICAL PRESTRESSED-CONCRETE PRESSURE VESSELS WITH AXIAL RIBS. Seboek, F. (Hungarian Academy of Sciences, Budapest). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Research carried out in Hungary has led to the conclusion that thick-walled prestressed concrete vessels not only involve difficulties in design calculations but are basically uneconomical since large dimensions impose increased thermal stresses. A solution is sought for by applying "disengaged" structures, exempt from significant thermal gradients and having sufficient rigidity. Research work is focussed on cylindrical shells with axial ribs. Rib interstices are filled with a good shielding and heat insulating material without inherent strength. Prestress is due to axial wires held in ducts in the ribs and tangential wires wound around the rib crests. Interesting design features for this novel pressure vessel are: (a) The temperature field of the two-layer wall has been specified in closed form, regarding the exponentially distributed internal heat sources due to the nuclear radiation absorbed, the thermal variations of the heat conductivity of concrete, and the heat loss conditions on the outer surface. Assuming temperature-dependent linear variations of Young's modulus, a method has been developed to calculate the effective rigidities of the shell and the triangular rib. A further refinement of the method is achieved by introducing the Davis-Glanville modulus of elasticity considering the creep rate as a linear function of temperature. Relevant computer data are to be presented. (b) A structural analysis has been worked out for the vessel based on the conventional energy method. As primary members the hinged, low-rise cylindrical shell and the beam supported elastically on the tangential prestressing wires are chosen. All loads are expanded in Fourier series. Equality of displacements yields a system of linear equations for each wave period. The developed method, programmed for data processing, permits investigation of the various conditions occurring in the vessel. In particular four cases were considered: only prestressing forces are acting; service loads are acting but the process of creep has not yet begun; service loads are acting, and the process of creep is finished; and no service loads are acting, but the structure is deformed by creep. Creep was considered by Dischinger's formula. (auth)

14775 (EUR-4820(Vol.4)(Pt.H), pp 551-568) INVESTIGATION ON A PRESTRESSED-CONCRETE REACTOR VESSEL UNDER INTERNAL GAS PRESSURE. Mode of Rupture. Lenschow, R. (Norges Tekniske Hoegskole, Trondheim, Norway). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In February 1971 the Cement and Concrete Research Institute, University in Trondheim, Norway performed tests to rupture on 2 models of prestressed concrete pressure vessels. The main purpose with this project, which is planned for a series of 6 models, is to study the mode of rupture of the vessel, loaded by internal gas-pressure. Model No. 1 is a model in scale $^1/_{3.6}$ of the Scandinavian PCRV-model except for the removable lid. The vessel has an inside dia of 55 cm and an inside height of 111 cm. The cylindrical wall thickness is 30 cm and the top and bottom slabs are 33 cm. The reference pressure is 85 bar. To stimulate the effect of shear capacity of the steel tubes in the Scandinavian model, model No. 1 is supplied solid steel bars in the top and bottom slabs. The vertical prestressing system consists of prestressing bars (System Dywidag). In the circumferential direction there are 10 bands, consisting of $^3/_8$ in. prestressing strands. The nominal prestressing forces in the tangential and axial direction are about 1.5 and 1.75 times the reference pressure load, respectively. In addition, there is bonded reinforcement that can take up 0.6 and 0.8 times the reference pressure, respectively in the tangential and axial directions (at yield). The inside of the vessel is lined by a mild-steel lining (thickness 3 mm), welded in argon-atmosphere. The concrete in the models has an average cylinder strength of 430 kp/cm^2. Model No. 2 is equal to No. 1, but has no bonded reinforcement in the cylindrical wall. The nominal prestressing forces in the tangential and axial directions are equal to model No. 1, but a greater amount of the prestressing reinforcement compensates for the absence of bonded reinforcement. (The influence of the bonded reinforcement on the mode of rupture is one of the parameters to be examined in the first stage of this project.) The models were instrumented with vibrating wire strain gauges in the concrete and electrical resistance strain gauges on the reinforcement and on the lining and thermocouples registered concrete temperature. Both models were loaded with an internal gas-pressure to failure. Model No. 1 failed by an extensive leakage at 270 kp/cm^2, model No. 2 however, exploded at 267 kp/cm^2 internal over-pressure. Both models had significant deformations and cracks before failure. The maximum measured deflections were about 25 times the deflections by the reference pressure. The tests results are interpreted and compared with computed values. Calculation of ultimate load is discussed. (auth)

14776 (EUR-4820(Vol.4)(Pt.H), pp 569-578) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE STRESS-STRAIN BEHAVIOR OF THE PRESTRESSED-CONCRETE PRESSURE VESSEL. Servit, R. (Technical Univ., Prague). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The stress-strain behavior of a thick-walled cylindrical prestressed concrete pressure vessel with originally designed secantial cable arrangement has been investigated since 1956. Finite differences methods working with displacements expressed in generally curvilinear, especially cylindrical, coordinates are derived and computed taking into account geometric irregularities. The large resulting matrices were subdivided for the smaller parts of the cylinder. Data from photo-elastic experiments verified the computed stress fields in the environs of the holes. (auth)

14777 (EUR-4820(Vol.4)(Pt.H), pp 579-594) GYPSUM CONCRETE MODELS FOR FAILURE TEST OF PCPV. Tsuboi, Y. (Tokyo Univ.); Kawamata, S.; Otsuki, Y.; Ichikawa, K. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A new technique of gypsum concrete model testing for PCPV was developed for the purpose of investigating the elastic response and the mode of failure. This method, enabling the failure testing of PCPV on a small scale, at low pressure, and during a short time, facilitates the study of design parameters from the viewpoint of failure mode and strength. Mixing and properties

of the gypsum concrete suitable for prestressing are reported and modeling techniques including a newly developed linear system and wire-winding device are presented. The results of a series of tests on 1:40-scale gypsum concrete models for a proposed design are presented and compared with those of parallelly tested microconcrete model. (auth)

14778 (EUR-4820(Vol.4)(Pt.H), pp 595-618) STRESS ANALYSIS OF LINERS FOR PRESTRESSED-CONCRETE PRESSURE VESSELS. Parker, J. V. (Nuclear Power Group Ltd., Knutsford, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Methods used since 1962 for the stress analysis of prestressed concrete pressure vessel (PCPV) liners are presented. While a finite element analysis of the PCPV can include the liner as a structural component, the behaviour of the liner near structural discontinuities in either the vessel or the liner, and also in the region of high strain gradients, can be analysed independently of the concrete provided that the load-deflection characteristics of the liner-to-concrete shear connectors or anchorages are known. The analysis takes into account the nonlinear load-deflection characteristics of the shear connectors and assumes that the liner material is ideally elastic-plastic. The idealized behaviour of liner panels in biaxial compression and the idealized behaviour of shear connectors are based upon laboratory experiments. Practical applications of the methods are presented with particular reference to the PCPV liners for the Hinkley Point "B" and Hunterston "B" AGR Power Stations. (auth)

14779 (EUR-4820(Vol.4)(Pt.H), pp 619-637) MATRIX DISPLACEMENT METHOD ON PRE- AND POST-BUCKLING ANALYSIS OF LINERS FOR REACTOR VESSELS. Yang, T. Y. (Purdue Univ., Lafayette, IN). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A matrix displacement method is suggested for the solution of instability problems for liners of nuclear containment vessels. The method uses the incremental stiffness formulations for the plate and shell discrete elements to predict the pre- and post-buckling behavior by either an iterative or an incremental procedure. The inclusion of initial displacement terms in the element formulations allows the method to account for the possible initial displacement of the liner caused by constructional inaccuracies. Applications are illustrated by using the formulation for a doubly curved shell discrete element. (auth)

14780 (EUR-4820(Vol.4)(Pt.H), pp 639-653) LINER PLATE BUCKLING AND BEHAVIOR OF STUD- AND RIP-TYPE ANCHORS. Doyle, J. M. (Univ. of Illinois, Chicago); Chu, S. L. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The evaluation of forces and deformations of liner plate anchors in containment structures is studied. These forces and deformations are due to buckling, and hence, reduce the load carrying capacity of a panel of the liner plate. Specifically, the behavior of headed studs and of continuous rib-type anchors is investigated. The stiffness characteristics of the anchors are based on experimental evidence, and are nonlinear. Parameters which are varied include the plate thickness, yield stress, and anchor spacing. The results of several representative configurations are presented from which behavior trends can be observed. It is found that an increase in yield stress of an amount often encountered in practice causes a large increase in anchor force and deformation. On the other hand, a plate thickness increase of 15% results in a much smaller increase of anchor force and displacement. (auth)

14781 (EUR-4820(Vol.5)(Pt.J)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 5. Reactor Plant Structures and Containment. Part J. Analysis of Shell Structures; Containment. Jaeger, T. A. (comp.). (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 430p. (In German and English). (CONF-710903-(Vol.5)(Pt.J)). EUR.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F.R. Germany) (20 Sep 1971).

Separate abstracts were prepared for 21 of the 27 papers included. Abstracts for 5 of the remaining papers have previously appeared in NSA. (JWR)

For abstracts of individual papers see: 14390, 14536, 14592-14595, and 14782-14796.

14782 (EUR-4820(Vol.5)(Pt.J), pp 5-16) RECENT EXPERIENCE ON THE DESIGN OF COMPLICATED SHELL SYSTEMS. Christ, G.; Fischer, D.; Zwingenberger, L. (Vereinigte Oesterreichische Eisen- und Stahlwerke AG, Linz, Austria). Mar 1972. (In German and English).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Compared with conventional engineering, nuclear engineering makes higher demands on the reliability, security and economy of steel structures. Optimum use of all resources and a reduction of the risk factors involved can only be achieved if the complete stress situation is known to a high degree of accuracy. The calculation of the stresses in spherical shells is discussed. Practical experience has shown that the combined use of the Finite Element Method and KALNIN's Direct Numerical Integration Method seems to be the most useful approach. This approach is not restricted to particular cases as are the analytical methods. The technique of numerical integration, although difficult to apply to shells with boxes and with various supports, leads to very accurate solutions. The Finite Element Method allows arbitrary configuration of shells, position of supports, combination with other structural elements as well as varying material constants. It takes, however, more effort to reach the same accuracy as the numerical integration techniques. The computation of non-radial nozzles in a spherical shell is presented as a practical example. (auth)

14783 (EUR-4820(Vol.5)(Pt.J), pp 17-36) CURVED FINITE ELEMENTS IN THE ANALYSIS OF SHELL STRUCTURES BY THE FINITE ELEMENT METHOD. Dawe, D. J. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The application of the finite element method to shell analysis has received considerable attention in recent years. The current stage of development for curved elements whose properties are based on the assumption of the Kirchoff hypothesis and on the application of the minimum potential energy principle is reviewed. Particular attention is paid to the requirements of assumed displacement fields for the curved elements. Some comparative numerical results of the finite-element studies are presented where appropriate. (auth)

14784 (EUR-4820(Vol.5)(Pt.J), pp 37-56) REFINED THEORY FOR CIRCULAR CYLINDRICAL SHELLS. Wu, C. G.; Lee, C. W. (Univ. of Tennessee, Knoxville). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A series solution for circular cylindrical shells under general loadings is obtained. The solution satisfies the field equations of three-dimensional linear theory of elasticity and the prescribed boundary conditions on the curved surfaces, but in general not the edge conditions. In the series solution the first terms are identical to those given by Donnell equations, the subsequent correcting terms involve higher derivatives of the loading function and also higher powers of the thickness-to-radius ratio. The present theory is applicable to thick-walled cylinders, and it shows that Donnell theory is a consistent one based on the order-of-magnitude criterion. (auth)

14785 (EUR-4820(Vol.5)(Pt.J), pp 57-76) ELASTIC ANALYSIS OF CRACKED THIN SHELLS BY THE FINITE ELEMENT METHOD. Carmignani, C. (Univ., Pisa, Italy); Cella, A. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The stiffness matrix is derived for finite elements with a singular stress distribution, and the procedure is given for its assembly into the global stiffness matrix. In particular, the elastic behavior of thin shells with linear cracks is analyzed using, in the neighborhood of the tip of the crack, elements with the asymptotic expansion of the solution as a shape function. Such matrices have been developed and tested for plane stress, plate bending and for cylindrical shells problems. (auth)

14786 (EUR-4820(Vol.5)(Pt.J), pp 77-89) ANALYSIS OF VISCOELASTOPLASTIC STRUCTURAL BEHAVIOR OF ANISOTROPIC SHELLS BY THE FINITE ELEMENT METHOD. Chung, T. J.; Eidson, R. L. (Univ. of Alabama, Huntsville). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The finite element method of analyzing an anisotropic viscoelastoplastic shell is described. A relaxation kernel in the form

of exponential series is used and conveniently expanded into a numerical time integration process. At each integration time increment, viscoelastic displacement and stress fields are determined; and these are subsequently used to iterate through incremental plastic loadings based on the Huber–Mises yield criterion and Prandtl–Reuss flow rule. For the successive time increments, the identical procedure is repeated with each step dependent on the results of the previous time increment. The anisotropic parameters are calculated and introduced into the yield function. These parameters are to be considered constant within an increment but may vary from one increment to another. Yielding of various points through the thickness of a shell is checked so that an appropriate treatment for the transition and unloading elements may be provided. Both perfect plastic and strain hardening behavior based on the isotropic hardening theory is considered in the analysis. It is demonstrated that the finite element technique is efficient and convenient for not only obtaining the necessary equations but also for solving iteratively and incrementally these equations with matrix arrays. Shells of various configurations, axisymmetrical, subjected to arbitrary loadings, distributed and concentrated can be treated. To demonstrate the theory and procedures, a numerical example of a spherical cap under uniformly distributed loads is presented. (auth)

14787 (EUR–4820(Vol.5)(Pt.J), pp 91-102) FORMULATION AND SOLUTION OF NONHOMOGENEOUS ANISOTROPIC CYLINDRICAL SHELL PROBLEM. Widera, O. E. (Univ. of Illinois, Chicago); Chung, S. W. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A first approximation shell theory is derived by use of the method of asymptotic integration of the three-dimensional elasticity equations for a nonhomogeneous anisotropic medium. The analysis is valid for materials which are nonhomogeneous to the extent that their properties vary with the thickness coordinate. Although twenty one elastic coefficients are allowed for in the original formulation of the problem, only six appear in the first approximation theory. Use of the asymptotic method also yields expressions for all stress components, including the transverse ones. This is important when discussing failure. The extension of this theory to laminated shells consisting of arbitrarily oriented homogeneous but anisotropic layers of different thicknesses is also shown. No symmetry of the layering needs to be assumed. For the particular case of a layered cross-ply shell, the effective material constants appearing in the shell matrix can be shown to have a simple form. This is due to the fact that for this case of layering, bending and stretching are uncoupled. To illustrate the application of the derived shell theory, the problem of a nonhomogeneous anisotropic cylindrical shell under internal pressure, fixed at one end and subjected to edge loadings at the other end is solved. (auth)

14788 (EUR–4820(Vol.5)(Pt.J), pp 105-132) LARGE DEFLECTION ELASTIC-PLASTIC ANALYSIS OF SHELLS OF REVOLUTION. Yaghmai, S. (Arya-Mehr Univ. of Tech., Teheran); Popov, E. P. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A general incremental variational method is developed for the analysis of a geometrically nonlinear elastic-plastic continuum and is used for the analysis of axisymmetrically loaded and supported thin shells of revolution. The variational procedure is formulated in the context of finite element method. The shell space is discretized into a number of annular curved finite elements whose displacements and slopes are continuous at the nodal circles. Third order polynomials are employed to express the in plane and out of plane displacements. Two additional degrees of freedom are produced because of this particular displacement assumption and are removed by static condensation. Kirchhoff's kinematic assumption is hypothesized and a shell theory with large deflections and rotations is employed. The material of the shell is assumed to obey von Mises yield condition and the incremental theory of plasticity. Each element is divided along its thickness into a number of layers for each of which the load-deformation history is monitored. Several examples are solved numerically and compared with available experimental results and other theoretical solutions. The agreement is good. (auth)

14789 (EUR–4820(Vol.5)(Pt.J), pp 133-143) LARGE DEFLECTIONS OF VISCOELASTIC ORTHOTROPIC CYLINDRICAL SHELLS. Brilla, J. (Inst. of Construction and Architecture, Bratislava). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Using the convolutional variational principle of minimum potential energy for viscoelastic bodies the basic equations of large deflection theory for viscoelastic anisotropic shallow are derived. These equations correspond to Kàrmàn–Donnel equations for elastic shallow shells. Then the solution of boundary value problems is transformed into the solution of a system of non-linear integro-differential equations. Further the symmetrical buckling of a cylindrical shallow shell, which is uniformly compressed in the axial direction, is analyzed. It is shown that, in general, there can occur not only infinite critical time but also finite critical times. (auth)

14790 (EUR–4820(Vol.5)(Pt.J), pp 145-157) EFFECT OF TIME-VARYING TEMPERATURE AND VARYING EXTERNAL PRESSURE ON CREEP COLLAPSE OF A CYLINDRICAL SHELL. Bargmann, H. (Technische Hochschule, Vienna). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The creep and creep-collapse of a long, thin-walled, circular, cylindrical shell subjected to external pressure is analyzed. Elasticity as a deformation mechanism is incorporated. For both time-varying external pressure and temperature, the basic equation is presented which describes the shape factor, i.e. the characteristic deformation that indicates the degree of distortion of the cross section at any time. For constant external pressure the basic equation can be integrated in a closed form. Moreover, for varying pressure a closed-form solution has been obtained for the particular case of the cubic creep law by applying a suitable transformation on the non-linear differential equation with time-dependent coefficients. From the results it may be concluded that elasticity must not be neglected in stability problems. Moreover, time-varying temperature as well as varying external pressure may lead to significant differences in the results compared to those of Hoff et al. (J. Aero/Space Sc. 26, No. 10(1959)). The critical time or lifetime of the tube which is a functional of mechanical and thermal loading is, in general, considerably reduced. (auth)

14791 (EUR–4820(Vol.5)(Pt.J), pp 159-171) NOTE ON THE FINITE DEFORMATIONS OF A THICK ELASTIC SHELL OF REVOLUTION. Oden, J. T.; Key, J. E. (Univ. of Alabama, Huntsville). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Finite deformations of a relatively thick highly elastic incompressible isotropic spherical shell subjected to external pressure are studied using the finite element method in conjunction with the method of incremental loading. Numerical results are presented and discussed. (auth)

14792 (EUR–4820(Vol.5)(Pt.J), pp 257-276) FINITE ELEMENT ANALYSIS OF CONTAINMENT VESSELS. Dhatt, G. S.; Venkatasubbu, S. (Laval Univ., Quebec). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A number of high precision triangular and quadrilateral elements are developed for analyzing plates and shells. The shear theory of thin shells is employed to formulate the stiffness matrix of the elements. A discrete equivalent of Kirchhoff assumptions is introduced over an element and the shear energy is neglected. Illustrative examples compare the efficiency of these elements for plates, cylinders and doubly curved shells. Pre- and post-buckling behavior of arbitrary shells is analyzed. The influence of different orientations of grid subdivisions on the buckling loads is studied. The results for different doubly curved shells are compared with those obtained by the Galerkin method and the finite difference method. The Newton–Raphson method is modified to automatically trace the complicated multisolution paths on a digital computer. The transient thermal stresses are studied for thick axisymmetrical shells. (auth)

14793 (EUR–4820(Vol.5)(Pt.J), pp 277-297) THERMAL EFFECTS IN WALLS OF NUCLEAR CONTAINMENTS: ELASTIC AND INELASTIC BEHAVIOR. Gurfinkel, G. (Univ. of Illinois, Urbana). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Design of containment structures requires evaluation of the thermal effects created by the temperature differential between inside and outside faces. Numerical methods are presented which permit evaluation of thermal effects on reinforced concrete sections subjected to axial load and bending. The wall section of an actual containment is studied for thermal effects under various

loading conditions using both elastic and inelastic analysis. The results are compared and interpreted using interaction diagrams. (auth)

14794 (EUR-4820(Vol.5)(Pt.J), pp 317-333) DETERMINATION OF THE DAMPING MATRIX IN DYNAMIC STRUCTURAL ANALYSIS OF A REACTOR CONTAINMENT. Yeh, G. C. K. (Bechtel Corp., Vernon, CA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In dynamic structural analysis of a reactor containment the mass matrix and the stiffness matrix can usually be determined from the physical properties of the undamped structural elements. But the damping matrix must be determined from appropriate assumptions on the damping characteristics of the system. Various possible methods of determining the elements in the damping matrix are examined. For each method considered the limitations and implications are illustrated by a numerical example. Typical numerical results show that as compared with an analysis using "nonproportional damping" matrix a design based on an analysis using "proportional damping" matrix can be much too conservative and a design based on an analysis disregarding the soil-structure interaction can be nonconservative. (auth)

14795 (EUR-4820(Vol.5)(Pt.J), pp 335-353) EXPERIMENTAL STUDY ON DYNAMIC ANALYSIS FOR PRESTRESSED CONCRETE CONTAINMENT VESSELS. Matsumoto, T.; Takeda, T.; Yamaguchi, T. (Ohbayashi-Gumi Ltd., Tokyo). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In order to get a reasonable prediction of dynamic behavior of the structure of prestressed concrete containment vessels for nuclear reactors (PCCV), an experiment was performed with a $1/10$ scale model for PCCV, mounted on an impact testing platform and subjected to an impact load. A comparison between the impact load test results of the PCCV model and the results of calculations was made and the propriety of the dynamic analysis method is discussed. The theoretical model for the dynamic analysis was constructed with consideration of rocking effects at the base, and the general equations derived were specialized to an idealized lumped-mass model. (auth)

14796 (EUR-4820(Vol.5)(Pt.J), pp 354-372) ANALYSIS AND TESTING OF PRESTRESSED CONCRETE NUCLEAR CONTAINMENT STRUCTURES. Bekowich, R. S. (Bechtel Corp., San Francisco). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A brief discussion of the analysis and testing methods developed by Bechtel for the engineering of the first generation of prestressed concrete nuclear containment structures which are currently in various stages of design and construction is presented. The discussion considers the overall response of the structure and the response of its components that require special consideration such as large penetrations, the liner system and tendon anchorage zones. Some pertinent results of the analysis, including two-dimensional and three-dimensional numerical solutions, are presented in graphical form. Results of the full-scale structural tests in the field are presented in several plots that show also the corresponding response of the structures as predicted by analysis. (auth)

14797 (EUR-4820(Vol. 6)(Pt. L), pp 85-108) CALCULATION OF THE TEMPERATURE DISTRIBUTIONS WITHIN THICK-WALLED REACTOR COMPONENTS DUE TO TRANSIENTS. Lange, W. A. (Siemens AG, Erlangen, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

For the calculation of thermal-stresses it is necessary to know the distribution of the temperatures or the gradient within the wall of a reactor component-especially due to transients. As an aid for the calculations of these distributions the computer program ROSYTA was developed for heavy sections symmetric with respect to rotation. This program has some special arrangements: (1) Different zones are provided for different heat transfer and different changes of temperature of the cooling flow. (2) It is possible to calculate the medium temperatures of particular spaces. (3) Special arrangements are provided to calculate the medium temperature of the studs. (4) All properties of the materials will be changed with the temperature. The main application of the program is the evaluation of input data for different stress calculation programs. Calculations to find out the behavior in extreme conditions (thermal shocks) can also be performed. Extreme differences of temperatures due to the heat transfer factor, the properties of the material, and wall thickness were calculated. Temperatures at particular points in a reactor pressure vessel will be measured and compared with the results of the calculation of the computer program. (auth)

14798 (EUR-4820(Vol. 6)(Pt. L), pp 251-270) INELASTIC ANALYSIS IN NUCLEAR EQUIPMENT DESIGN. Cloud, R. L. (Teledyne Materials Research Co., Waltham, MA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Specific interactions of inelastic analysis with design criteria are discussed, including the application of limit analysis principles to the ASME Nuclear Code; the impact of inelastic finite element methods; the key role of the strain hardening parameter in bursting and ductile cracking; and finally a discussion of inelastic methods for high temperature design. (auth)

14799 (EUR-4820(Vol. 6)(Pt. L), pp 271-291) NONLINEAR CREEP ANALYSIS AT ELEVATED TEMPERATURE. Chang, T. Y. (Univ. of Akron, OH); Rashid, Y. R. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A non-linear creep analysis method is developed for solving two-dimensional structures (plane stress, plane strain and axisymmetric) subjected to time-dependent mechanical as well as thermal loadings. The numerical solution is obtained within the framework of the finite element method following an incremental procedure. In this analysis the creep behavior of metals at high temperatures is assumed to follow a mechanical equation of state in which the creep rate is assumed to be a non-linear function of stress, creep strain, temperature and time. The creep strains are assumed to remain small throughout the deformation history and thereby no plastic strains are introduced. Two engineering theories of creep, namely the time-hardening and the strain-hardening rules, which utilize creep data from constant-stress and constant-temperature tests are considered. A special feature of the method is the treatment of temperature effects on the basis that the time-temperature shift hypothesis is valid for metals subjected to non-uniform transient temperature fields. This permits the analysis of reactor components under cyclic temperatures and hence provides the means for evaluating the effects of creep on the fatigue life of such structures. A computer program which is capable of handling large-size problems was developed. Moreover, the material properties incorporated in the computer program can be easily updated when such information becomes available. For demonstration, numerical examples are presented to show the creep effects due to arbitrary changes in stress and temperature histories. (auth)

14800 (EUR-4820(Vol. 6)(Pt. L), pp 311-326) THERMAL AND CREEP ANALYSIS OF CYLINDRICAL SHELLS UNDER INTERNAL PRESSURE. Bychawski, Z. (Technical Univ., Krakow). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A simultaneous thermal and nonlinear viscoelastic analysis of a circular cylindrical shell belongs to the group of problems in structural mechanics of reactor technology which have the most important practical significance. An interesting point of the analysis is the form of distributions of moments and internal forces due to nonlinearity of the shell material. This point has not been clarified satisfactorily in previous papers on the subject because of fargoing simplifications made. Furthermore, the influence of temperature field is not taken into account. A more adequate approach in investigating thermal effects and creep of circular cylindrical shells under internal pressure, on the basis of interaction of internal forces. The analysis is done by applying a theory of nonlinear viscoelasticity given by Bychawski and Fox, generalized here by accounting the influence of temperature. Two variants of the theory are considered, one that of small nonlinearity and the other of the Odqvist creep theory which follows as a particular case. The difference is pointed out between fundamental equations derived compared to those of other papers. In particular, some resulting equations are solved in exact manner and solutions discussed. (auth)

14801 (EUR-4820(Vol. 6)(Pt. L), pp 327-340) STRESS ANALYSIS OF TWO-DIMENSIONAL PROBLEMS UNDER SIMULTANEOUS CREEP AND PLASTICITY. Rashid, Y. R. (General Electric Co., San Jose, CA); Chang, T. Y. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In many reactor components which operate at high temperatures, thermally activated creep and plasticity occur simultaneously under cyclic conditions. Because of possible degradation of the fatigue life of such structures, it is necessary for the designer to determine, as an essential part of the design process, reasonably accurately the time-dependent response of these components under postulated load histories. With this objective in mind, a method of analysis is developed for plane and axisymmetric problems of arbitrary geometry subjected to arbitrary loading and transient non-uniform temperature fields. In an attempt to introduce the dependence of the material response on past history, a phenomenon which is encountered in viscoelastic materials and which has been observed to exist in metals under high temperature, the constitutive equations are formulated on the basis of the memory theory of creep. Embodied in these equations is the time-independent elastic-plastic stress strain relations for isotropic materials, with kinematic strainhardening. Ziegler's modification of Prager's rule is considered. Because of limitations on presently available material data required for the memory theory of creep, an alternate formulation based on the mechanical equation of state is also considered. In this connection two engineering creep theories are used: the time-hardening rule and the strain-hardening rule. The numerical analysis is obtained within the framework of the finite element method and a step-by-step solution procedure is used. Numerical examples illustrating the combined effect of creep and plasticity will be given. (auth)

14802 (EUR-4820(Vol. 6)(Pt. L), pp 373-389) TIME-DEPENDENT CREEP IN METALLIC COMPONENTS: NOZZLE ENTERING A SPHERICAL PRESSURE VESSEL. Penny, R. K. (Univ. of Liverpool). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A method of calculating creep deformations based on the corresponding elastic problem is described. The starting point in the analysis is the elastic solution so that a single computer program can be used to calculate stress redistribution caused by creep to a state of stationarity. This procedure has been applied to the nozzle problem in order to arrive at conclusions that will be useful in design. (auth)

14803 (EUR-4820(Vol. 6)(Pt. L), pp 472-487) LOW-CYCLE FATIGUE STRENGTH OF NOZZLE-END WELDMENTS FOR REACTOR PRESSURE VESSEL. Kusumoto, S.; Murakami, Y. (Hitachi Ltd., Ibaraki, Japan). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The fatigue strength of the partial penetration welds such as those between the control rod drive housing and the stub tube or between the thermal sleeve and the nozzle was studied. Throughout this experiment, 59 specimens of two-dimensional model and a specimen of three-dimensional model in the nearly identical shape as the actual part were used. The experiment with the two-dimensional model revealed information on size effect, temperature effect, crack propagation characteristics, strength of 18% Cr-8% Ni stainless steel and Inconel, and effect of stiffness of the support. Finally, a method to estimate the fatigue life was proposed and applied to the three-dimensional model. (auth)

14804 (EUR-4820(Vol. 6)(Pt. L), pp 523-534) FRACTURE MECHANICS APPROACH TO THE PROPAGATION OF FATIGUE CRACKS IN REACTOR COMPONENTS BY ACOUSTICALLY INDUCED STRESSES. Jerram, K. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Fatigue crack propagation caused by high frequency cyclic stresses whose peak values conform to a Rayleigh distribution has been theoretically investigated. It is shown that the two crucial crack propagation parameters for predicting crack propagation under such conditions are the minimum propagation rate and the criterion for non-propagation. Simple formulae are derived for the permitted r.m.s. stress and the permitted life for a component containing a crack. The simple formulae are shown to give values in good agreement with those calculated using a crack propagation summation analysis for an edge cracked beam subjected to more than 5×10^{10} random amplitude stress cycles. (auth)

14805 AUGMENTATION OF NATURAL-DRAFT EVAPORATIVE COOLING TOWER PERFORMANCE. Flanagan, T. J.; Golay, M. W. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 16: 31-32(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14806 DESIGN FOR PIPE BREAK OUTSIDE OF CONTAINMENT. Harper, B. E.; Shipley, L. E.; Schwartztrauber, K. E. (Bechtel Corp., San Francisco). Trans. Amer. Nucl. Soc.; 16: 226(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14807 ANALYSIS FOR EFFECTS OF PIPE RUPTURE: STATE-OF-THE-ART. Keever, R. E.; Randall, G. A. Jr. (Nuclear Service Corp., Campbell, CA). Trans. Amer. Nucl. Soc.; 16: 226-229(Jun 1973).

From 19th annual meeting of the American Nuclear Society, Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14808 DESIGN OF STRUCTURAL SUPPORTS FOR PIPE BREAK LOADS. Walser, A. (Sargent and Lundy Engineers, Chicago). Trans. Amer. Nucl. Soc.; 16: 229(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14809 PROGRESS IN THE DEVELOPMENT AND APPLICATION OF ACOUSTIC SURVEILLANCE INSTRUMENT SYSTEMS. Gopal, R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 233-234(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14810 NEW REACTIVITY METER BASED ON NONLINEAR FILTERING TECHNIQUE. Shinohara, Y.; Oguma, R. (Japan Atomic Energy Research Inst., Tokai). Trans. Amer. Nucl. Soc.; 16: 235-236(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14811 AGE OF ^{252}Cf FISSION NEUTRONS TO INDIUM-RESONANCE ENERGY IN WATER. Spiegel, V. Jr. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 283(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

Reactor Fuels

Refer also to abstracts 13118, 13121, 13124–13126, 13128–13130, 13135, 13257, 13260, 13261, 13326, 13352, and 13354.

14812 (EUR-4820(Vol.2)(Pt.C)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 2. Reactor Core. Part C. Fuel and Cladding. Jaeger, T. A. (comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 345p. (In German and English). (CONF-710903-(Vol.2)(Pt.C)). EUR.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

Separate abstracts were prepared for 16 of the 24 papers included. Abstracts for the remaining papers have previously appeared in NSA. (JWR)

For abstracts of individual papers see: 14355–14357, 14404, 14405, 14581, 14582, 14717–14721, and 14813–14816.

14813 (EUR-4820(Vol.2)(Pt.C), pp 179-194) THERMAL STRESSES IN CLAD, PELLET STACKS AND THE PROBLEM OF INTERFACE STRESS STATES. Carey, J. J.; Valentin, R. A. (Argonne National Lab., IL). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An analytical solution is presented for the elastic interaction of fuel pellets and cladding in the limiting case of zero interface shear. In particular, expressions are developed for the contact stress between cladding and fuel in the neighborhood of a pellet-to-pellet interface. The formulation assumes a pellet description which is exact within the classical theory of elasticity while the cladding is approximated by a simple shell theory. Extensive numerical results give interface pressure distributions for various ratios of the occurring elastic and geometric parameters. Of interest are the areas of reduced local pressure slightly away from the pellet edge due to the "bridging" effect of the cladding caused by the local high curvature of the pellet. Deformed shapes of the fuel element are given for various strengths of cladding ranging from very soft to infinitely rigid. Included is the stress concentration factor applicable to the plane strain value of the interface pressure to give the true localized maximum normal stress. (auth)

14814 (EUR-4820(Vol.2)(Pt.C), pp 195-208) MECHANICAL FUEL-CAN INTERACTION EFFECTS ON FUEL ELEMENT

THERMAL FREQUENCY RESPONSE. Thompson, J. J. (Univ. of New South Wales, Kensington, Australia). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A linear thermoelastic model has been used in a study of the effect of including the contact pressure dependence of the fuel can contact conductance, in the equations describing both the symmetric thermal frequency response to power and coolant or heat transfer fluctuations, and the asymmetric static problem of slightly tilted power and coolant temperature distributions. In the latter, an analytical solution was feasible and formulas for the can surface heat flux are given. The former was reduced to coupled equations by Galerkin's method and solved by a general linear analysis computer code. A specific example is discussed. In both cases the inclusion of the pressure dependent conductance was most significant for internal power rather than coolant temperature changes, and was influenced by the temperature dependent fuel conductivity. Errors of the order of 10% due to neglecting this effect were obtained for the example chosen. The Galerkin method, using a third order polynomial for can temperature, and a sixth order even polynomial for the fuel was found to be adequate over a frequency range from 10^{-3} to 10^{2} radians per second. (auth)

14815 (EUR-4820(Vol.2)(Pt.C), pp 223-244) THERMAL STRESSES IN CLAD FUEL ELEMENTS. Part I. Cylindrical Fuel Elements. Part II. Spherical Fuel Elements. Smith, C. O. (Univ. of Detroit). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Equations for the thermal stresses developed in internally and externally clad cylindrical elements with radially symmetric temperature distribution are presented. For illustration, temperature and thermal stress distributions for four fuel element configurations (three cylindrical and one flat plate) with uniform heat generation in the fuel and no heat generation in the cladding are pictured and compared. Some conclusions of practical significance are drawn from this comparison. Equations are presented for the thermal stresses developed in externally clad hollow spheres with radially symmetric temperature distribution. The case of clad solid and hollow spherical fuel elements, having uniform heat generation in the fuel and no heat generation in the cladding, are used for illustration. The temperature and thermal stresses developed in the clad hollow element are calculated on deterministic and probabilistic bases (taking into account the range of all variables concerned). A comparison of the two sets of values is made with particular reference to reliability in design. (auth)

14816 (EUR-4820(Vol.2)(Pt.C), pp 265-283) TREATMENT OF THE MECHANICAL AND THERMAL BEHAVIOR OF FUEL RODS BY "SATURN 1". Depisch, F. (AEG-Telefunken, Grosswelzheim, Ger.); Elbel, H.; Kaempf, H. Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In SATURN 1 the time history of a fuel pin concerning the radial distributions of temperature, stress, porosity and geometry changes is calculated. The operating fuel pin conditions such as linear rod power, outside temperature of the cladding, and outside pressure are time dependent input data, so steady state and cyclic conditions are taken into account. The following material phenomena essential for the mechanical and thermal behavior are interconnected in SATURN 1: creep of fuel and clad, swelling of fuel and clad, thermal expansion, crack formation, fission gas release, porosity migration, and heat transfer fuel-clad. Three thermal-mechanical states are distinguished: a) fuel and clad in mechanical interaction; b) freestanding fuel and clad stressed by gas and coolant pressure; and c) freestanding stressed clad in contact or not in contact with cracked fuel assumed to be free of stresses. Three fuel zones are distinguished especially with view to different creep and porosity migration behavior. To demonstrate the manifold possibilities of SATURN 1 several illustrative applications are given. (auth)

14817 (EUR-4820(Vol.2)(Pt.D)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 2. Reactor Core. Part D. Fuel Elements. Jaeger, T. A. (comp.). (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 286p. (In German and English). (CONF-710903-(Vol.2)(Pt.D)). EUR.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

Separate abstracts were prepared for 17 of the papers included. (JWR)

For abstracts of individual papers see: 13241, 13242, 13352-13354, 14307, 14358-14364, 14818-14820, and 14835.

14818 (EUR-4820(Vol.2)(Pt.D), pp 1-20) RESPONSE OF A TIGHTLY CLUSTERED NUCLEAR FUEL ELEMENT BUNDLE TO ARBITRARY INITIAL THERMAL AND MECHANICAL LOADING CONDITIONS. Baumgartner, A. J. (Atomics International, Canoga Park, CA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The mechanical response of nuclear fuel elements (thin-walled tubes) to their thermal environment is closely controlled by a system of mechanical constraints and support conditions. These two factors determine primarily the mechanical interactions between and relative deflections of the fuel elements. The relative deflection response, in general, modifies the initial (nominal) geometry of the coolant flow channels, and with it the associated temperature distribution in the flow channels. Finally, this new temperature distribution about the fuel elements replaces the initial nominal temperature environment. The solution to this problem requires determination of the steady-state relationship between all fuel element force-deflection responses, and the temperature distribution in all coolant flow channels. This situation clearly suggests a solution approach involving iterations, as indicated subsequently. The initial phase of the method treats each element of the bundle on a noninteractive basis. A set of equations is developed to convert the arbitrary circumferential temperature distribution into an equivalent linear diametral thermal gradient. Next, the corresponding rotation of the end faces, including associated angular directions, is determined for each incremental element length. A unique computer algorithm was developed to assemble these incremental beams into a continuous 3-dimensional "free-bow" shape for each fuel element. Placing each of the "free" elements into its designated location within the bundle sets the stage for studying the interactions between these elements. The task of determining the inter-element force at points of interference is accomplished by an iterative scanning procedure. Each subsequent round of iteration modifies the initial set of interference forces to more closely result in a near-zero gap at the points of initial interference. The last phase of the interference study procedure determines a modified set of initial thermal conditions compatible with the new coolant channel geometries, as defined by the mechanical iteration results. Derivation of the new flow channel temperatures assumes that, at a given element channel nodal point, heat flow rates and axial coolant pressure gradients remain essentially unchanged from the initial conditions. A new round of thermal iterations begins at this point, on the basis of the new thermal conditions. The acronym for the associated computer program is "SAS3D." It is written in FORTRAN IV and is operated on the IBM-360/65 or 360/85 System. (auth)

14819 (EUR-4820(Vol.2)(Pt.D), pp 39-45) EXPERIENCES AND LIMITATIONS OF NONDESTRUCTIVE TESTING OF FUEL RODS. Gloeckner, W. (AEG-Telefunken, Grosswelzheim, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Nondestructive testing plays an important role in quality control during fuel element fabrication. The various kinds of microdefects in the tubings and end-plug weldings of fuel rods are identified. Testing procedures most applicable for these specific defects and their limitations are described. (auth)

14820 (EUR-4820(Vol.2)(Pt.D), pp 185-203) THREE DIMENSIONAL TRANSIENT THERMOELASTIC STRESSES IN CONSTRAINED SPHERICAL FUEL ELEMENTS. Ng, F. W.; Kettleborough, C. F. (Texas A and M Univ., College Station). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Transient three-dimensional heat conduction and thermal stresses in spherical fuel elements of pebble bed reactors, with points of constraint where the fuel spheres are in contact with adjacent spheres, are considered. Dynamic Relaxation (DR) is the numerical technique used to obtain both the temperature and the stress fields. Numerical results are presented in the form of isothermal and constant stress contours. The most severe conditions are found to exist at the points of constraint under steady state conditions, with $E\alpha T/(1-2\nu)$ being a conservative estimate of the maximum normal stress attained. (auth)

14821 (EUR-4820(Vol.3)(Pt.E), pp 3-13) VISCOUS DAMPING OF RAPIDLY HEATED FUEL RODS. Grossman, R. J.; Hamilton, L. J. (Univ. of Michigan, Ann Arbor). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The response of a rapidly heated solid rod, immersed in a viscous fluid, is investigated for both zero stress and zero displacement end conditions. The zero stress solution is an infinite series of terms, each with the same form as the zero displacement solution. The analytic results are confirmed by an experiment which uses a laser interferometer to detect the sample displacements. The rapid heating is achieved by discharging a high energy capacitor through a low inductance circuit containing the sample. The viscous damping of a thin walled cylinder by glycerin is measured; the agreement between theory and experiment is good. (auth)

14822 (EUR-4820(Vol.3)(Pt.E), pp 247-275) HYDROELASTIC VIBRATIONS OF REACTOR FUEL RODS SUBJECT TO PARALLEL TURBULENT FLOW. Kanazawa, R. M. (General Electric Co., San Jose, CA); Boresi, A. P.; Jones B. G. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The vibration of fuel rods excited by turbulent flow parallel to the rod axes was studied. A probabilistic mathematical model of a fuel rod is developed. The probable rod response, in the form of root-mean-square displacement and of normalized spectrum of rod response, was computed in order to demonstrate application of the mathematical model. Since rod surface pressures are as yet poorly determined, a boundary layer pressure distribution for flat plates due to Corcos is used as input to the model. The nature of the rod surface pressure in relation to the structure of the flow field is discussed. The interrelations of the fluid velocity and the fluid pressure fields with the wall pressure are examined. A possible technique for examining the surface pressure-flow field structure is presented. (auth)

14823 (EUR-4820(Vol.3)(Pt.E), pp 317-328) SELF-SUSTAINED VIBRATIONS OF RODS IN PARALLEL FLOW. Avanzini, P. G. (Progettazioni Meccaniche-Nucleari S.p.A., Genoa). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A correlation is reached between the maximum displacement in the self-sustained vibration of a cylindrical rod of a bundle in parallel flow and the system's physical and geometrical parameters. Predicted displacement values agree well with experimental data reported by several authors. (auth)

14824 (EUR-4820(Vol.3)(Pt.E), pp 329-347) RESPONSE OF A CYLINDRICAL CANTILEVER TO AXIAL AIR-WATER FLOW. Harris, R. W.; Holland, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A review of existing work in the field of flow-induced vibration indicates that the significant driving forces in a two-phase flow originate from turbulence and bubble impacts, and the dominant damping mechanism is associated with the drag forces. Spectral and correlation analysis are important aspects of the experiments performed because the physical processes are random in nature. Flow-induced vibrations of a cylindrical cantilever in an axially flowing air/water mixture were measured, as well as wall pressure fluctuations near the free end of the vibrating cantilever. The results obtained for void fractions up to approximately 25% and constant mass flow (equivalent to 63.6 l/min of water) are presented for the two conditions of flow on to the free end of the cantilever ("free-end-flow") and directly on to the fixed end (and then over the free end) ("fixed-end-flow"). The theoretical prediction of an increase in the amplitude of vibration for increasing voidage was observed, with deviations at low voidages due to turbulence effects and at higher voidages due to flow separation. The theory predicted that the damping and the resonant frequency of the cantilever would increase with increasing voidage, and these general trends were observed. (auth)

14825 (EUR-4820(Vol. 3)(Pt. F), pp 145-168) LATERAL DEFORMATION OF COUPLED TUBULAR STRUCTURES. Barinka, L. L. (Babcock and Wilcox Co., Lynchburg, VA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An analysis is presented for determining the lateral deflection characteristics of coupled tubular structures such as reactor fuel assemblies. The tubular structures are analyzed by considering the assembly of tubes to be subdivided into axial segments between discrete coupling locations. The governing relations are based on the deformation of the individual tubes between adjacent coupling locations and are developed for structures consisting of any number of different types of tubes. The end product is a well-behaved system of linear algebraic equations, which is solved under iteration of applied loading for the large (nonlinear), lateral deflections of each tubular segment. Simplified, closed-form expressions are also presented to cover small (linear) deformation of tubular structures. Numerical results for several reactor fuel assemblies are presented and compared with experimental measurements to demonstrate the accuracy of the analysis. A sample parametric investigation for reactor fuel assemblies is also included to illustrate quantitatively the effects of varying pertinent design parameters. 4 references. (auth)

14826 (EUR-4820(Vol. 6)(Pt. L), pp 41-55) DYNAMIC TEMPERATURE DISTRIBUTION OF A POWER REACTOR FUEL ELEMENT. Forghieri, R.; Orru, G.; Papa, G. (CNEN, Bologna). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An accurate model for the dynamic heat transfer of a power reactor with a cylindrical type fuel element is presented. We consider a cylindrical fuel element composed of a hollow fuel core and its cladding, separated by a vacuum gap. We suppose these two regions homogeneous and isotropic with thermal properties independent from the temperature. The mathematical model is based on heat diffusion equations in fuel and cladding with radiative heat transfer in the vacuum gap between them and on the convection equation for the coolant fluid. The integration of the equations with respect to the variables involved in the problem is performed by the following steps: first, we operate the separation of the radial variable by means of modal expansion via a finite integral transformation specially constructed for a multiregion system; then, we arrive to an integral-differential equation system for time and the axial variable. Lastly, the Laplace transform with respect to time reduces the problem to a system of ordinary differential equations in the axial variable. An analytical integration performed for this variable gives axial temperature and power transfer functions particularly suited for analog simulation. The long term solution is then obtained by an iterative numerical procedure whose steps reproduce on the digital computer the cascading blocks of the analog simulation. The short term solution, particularly interesting for the thermoelastic and safety analysis of power plants, needs a different handling because the iterative procedure converges too slowly. Therefore we construct this solution by numerical inversion of the Laplace transform of the indicial response and by convolution operations. (auth)

14827 REACTIVITY TESTING OF REACTOR FUEL AND STRUCTURAL MATERIALS. Haskins, J. J.; Kosanke, H. D. (General Electric Co., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 16: 88-89(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14828 NUCLEAR FUEL ROD ACTIVE GAMMA SCAN SYSTEM. Ruiz, C. P. (General Electric Co., Pleasanton); Duckart, A. C.; Menick, J. E. Trans. Amer. Nucl. Soc.; 16: 89-90(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14829 FUEL ELEMENTS FOR GAS- OR LIQUID-COOLED NUCLEAR REACTORS. Dohmen, A. (to Interatom Internationale Atomreaktorbau GmbH). German Patent 1,564,219. 19 Feb 1970. Filed date 22 Dec 1966. 11p. (In German).

A fuel element for gas- or liquid-cooled reactors in which the fuel is in the form of rods kept parallel to each other in a jacket was described. The coolant flows from both the top and the bottom. There are guide plates for directing the coolant flow. The guide plates are built as plane individual plates inclined at an angle of about 45 to 60° to the radial plane of the jacket, provided with openings for the fuel rods, and extending over a sector of about 45 to 70°. Several guide plates are arranged sloping in the axial direction at a distance from each other and displaced in their radial plane about their angular sector. In the use of a central cylindrical moderator element introduced into the jacket, axially and radially displaced guide plates are installed between the moderator element and the jacket. (JSR)

14830 THEORETICAL ANALYSIS OF THE EXPERIMENTAL MIXING AND DNB-BEHAVIOR OF A 37-ROD BUNDLE USING THE SUBCHANNEL PROGRAM THERMOHYDRAULIC. Ulrych, G.; Friedrich; Eicheler (Siemens AG, Erlangen, Ger.). (1973). vp.

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

For a refined thermal design of a rod bundle of a reactor core, it is necessary to take into account the influence of the different sizes of the subchannels and the spacers on the DBN-margin at normal and overload conditions. In order to check the applicability of the program THERMOHYDRAULIC for design purposes, mixing experiments have been carried out at Siemens for a 37-rod bundle, and a DNB-Test at MAN with a sector of the same bundle containing 6 heater rods. The calculations and experiments are in agreement, showing that current computational practice results in a conservative design. (GE)

Reactor Control Systems

14831 (AI-AEC-13073) SCRAM CONTROLLER AND AUTOMATIC CONTROLLER 5-KWE REACTOR THERMOELECTRIC SYSTEM. Tuttle, R. J. (Atomics International Div., Canoga Park, Calif. (USA)). 25 May 1973. Contract AT(04-3)-701. 55p. Dep. NTIS $4.75.

The design objectives and limitations developed for the scram and automatic controllers are discussed in detail, and to a lesser extent, for the manual and computer control systems and the backup shutdown mechanism. Digital computer simulations used to analyze startup methods are described and the results presented for several candidate methods. The selected startup method uses three reactivity insertion rates to provide a startup satisfying the design objectives and limitations. Improvements in this startup method are recommended. Functional requirements of the automatic and scram controllers are discussed and means of implementing these functions by use of integrated circuits are proposed. (auth)

14832 (AI-AEC-13080) ZIRCONIUM HYDRIDE REACTOR CONTROL DRIVE ACTUATOR DEVELOPMENT. Summary Report. Donelan, L. E. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-701. 50p. Dep. NTIS $4.50.

Actuators for compact space nuclear reactor reflector control have progressed from modified commercial units with relatively short life and low reliability at moderate temperature, to units custom designed for specific application. These latter units have demonstrated long life and high reliability at high temperatures. The design for a specific application includes the ability to design for various torque and step sizes, and the ability to control the relative proportions (length and diameter) of the actuator. The present status of design calculation capability incorporates reliable computer programs to facilitate the design and selection of the actuator, in the form of: (1) a stepper motor program to calculate actuator performance based on physical configuration, (2) an actuator brake program to calculate the magnetic performance based on a physical brake configuration, and (3) a bearing program to calculate loads and clearances for initial end bell and bearing interferences and journal dimensions. Using the preceding programs and various other supporting calculations, a control drive actuator has been designed for the 5-kW(e) Reactor Thermoelectric System, to fit in the available space within the reflector and shield configuration. This actuator will develop sufficient torque for both the specified stepping drive control and the scram requirement, at current densities no greater than the proven SNAP 8 Developmental Reactor design. A brief history is presented of the progress of actuator design, development, and tests to date, as well as the design calculations applicable to the actuator designed for the 5-kW(e) Reactor Thermoelectric System. (auth)

14833 (AI-AEC-13086) CONTROL WORTH OF SLIDING REFLECTORS FOR ZIRCONIUM HYDRIDE REACTORS. Bost, D. S. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-701. 31p. Dep. NTIS $3.75.

Results of measured and calculated worth of sliding reflectors on the SNAP Critical Assembly are presented. Two quadrants on opposite sides were fitted with new tapered beryllium reflectors. The existing reflectors and control drums were used in the other two quadrants. The new reflectors were cut to allow measurement of the worth of sliding reflectors over a range of angles (30, 60, and 90°) and strokes (2, 2¾, and 3½ in.). A maximum worth of $8.01 was obtained for both 90° segments open 3½ in. Two-dimensional DOT III calculations in R, Z geometry gave a worth of $6.54. (auth)

14834 (EIR-206) OPTIMAL COMMAND OF A NUCLEAR POWER PLANT GCFR WITH THE HELP OF QUADRATIC PROGRAMMING. Raboud, P. B. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1972. 198p. (In French). Dep. NTIS (U. S. Sales Only) $12.00.

The optimum command strategy of the GCFR power plant was determined for a given time interval. The physical processes were first represented by mathematical relations. The dynamic behavior of the process was simulated in order to determine the essential properties. A performance criterion was defined. Mathematical expressions were chosen for the constraints on the process variables. The expressions were chosen so as not to complicate the calculation of the optimal strategy with the aid of an algorithm of the operational research. (83 references) (tr-auth)

14835 (EUR-4820(Vol.2)(Pt.D), pp 273-286) DESIGN CONSIDERATIONS FOR CONTROL RODS FOR DIRECT INSERTION INTO A PEBBLE BED REACTOR. Cramer, H.; Rohark, G.; Marek, H. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The shutdown system of the THTR is based on rods which are directly inserted into the pebble bed without any guidance in the graphite structural material. To prove this principle the characteristic parameters have been examined with the aim to develop an actuator by which the rods can be inserted into the pebble bed at any time. The system is characterized by: integration into the PCRV; double independent He-pneumatic drive; accessibility and possibility of maintenance on load; and maximum possible elimination of sliding parts considering the special conditions under He. Three main topics considered for the study of parameters and environmental conditions include: friction, gas pressure, density of the pebble-bed, bending of the rods by the sphere flow; behavior of the drive components in He at 260°C; and operational safety aspects of longterm behavior of special individual components. (auth)

14836 (GULF-GA-A-9354) EXPERIMENTAL AND ANALYTICAL RESULTS FOR HTGR TYPE CONTROL RODS OF HAFNIUM AND BORON IN THE HTGR CRITICAL FACILITY. Nirschl, R. J.; Gillette, E. M.; Brown, J. R. (Gulf General Atomic Co., San Diego, Calif.). 31 Jan 1973. Contract AT(04-3)-167. 92p. Dep. NTIS $6.75.

The reactivity worth of typical large HTGR type control rods containing either boron or hafnium was determined. Measured results were compared with the results obtained from calculations made for use in the design of HTGR type reactors. (FS)

14837 INVESTIGATIONS OF HTGR PLANT CONTROL SYSTEMS. Giegler, D. P.; Haake, E. V. (Gulf General Atomic Co., San Diego, CA); Trans. Amer. Nucl. Soc.; 16: 19(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14838 APPLICATIONS OF MODERN CONTROL THEORY TO NUCLEAR POWER PLANTS. Tsai, T. Y. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 16: 20(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14839 INDUSTRIAL INTERESTS IN ACADEMIC RESEARCH IN LMFBR DYNAMICS AND CONTROL. Heck, F. M. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 20-21(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14840 HYDRAULIC AND SCRAM DYNAMICS ANALYSIS ON LMFBR CONTROL ROD ASSEMBLIES. Carelli, M. D.; Bach, C. W.; Markley, R. A. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 16: 218-219(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14841 DEVELOPMENTS IN COMPUTER CONTROL OF CANADIAN NUCLEAR POWER STATIONS. Morris, D. I. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 16: 233(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14842 SPATIAL EFFECTS IN REACTIVITY DETERMINATION IN LARGE REACTORS. Ferguson, K. L.; Poncelet, C. G.; Impink, A. J. (Carnegie-Mellon Univ., Pittsburgh). Trans. Amer. Nucl. Soc.; 16: 262-263(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14843 ARTIFICIAL INTELLIGENCE APPROACH TO NUCLEAR REACTOR CONTROL. Macdonald, L.; Koen, B. V. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 16: 299-300 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14844 TEST OF CNEN NEUTRONIC CODES FOR Ag-In-Cd RCC IN PWRs. Gaafer, M. A. (Atomic Energy Agency, Cairo); Pistella, F.; Orestano, F. V. Trans. Amer. Nucl. Soc.; 16: 326-327(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14845 CONTROL OF POWER REACTORS. Crowther, R. L. (General Electric Co., San Jose, CA). pp 135-181 of Developments in the Physics of Nuclear Power Reactors. Pop-Jordaov, J. (ed.). Vienna; International Atomic Energy Agency (1973).

After a brief introduction categorizing the various control methods, sections are included on thermal reactor control system design, finite difference diffusion theory methods, approximate methods for multigroup calculations, burnable absorbers, and fertile control. (JWR)

14846 EFFICIENCY OF CONTROL RODS IN HIGH TEMPERATURE REACTORS. Calculation Method and Required Accuracy for the PR 500. Neef, H. J. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

The dependence of rod efficiency on rod number, rod arrangement and dipping depth for a low-enriched process heat-pebble bed reactor with 500 MW(t) is calculated using a three-dimensional diffusion program. (GE)

14847 ANALYSIS AND MEASUREMENT OF CONTROL ROD EFFECTS FOR LMFBR DEMONSTRATION PLANTS. Bailey, H. S.; Stewart, S. L.; Greebler, P. (General Electric Co., Sunnyvale, CA). (1973). vp.

From topical meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Juelich, Germany (23 Jan 1973).

A typical core and control system design of a 200 to 400 MW(e) demonstration plant is briefly described. Values of power distribution and control rod worths, measured in the ZPPR-3, are compared with the calculated ones and used for predicting the control system influence on the parameters of the demonstration plant. (GE)

Nuclear Power Plant Economics

Refer also to abstract 14840.

14848 (CONF-721109-23) SCOPE OF THE INTERNATIONAL NUCLEAR INDUSTRY. Jones, C. F. (NUS Corp., Washington, D. C.). 1972. 109p.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

The topics discussed include the need for nuclear power, nuclear power station costs, the nuclear plant industry, the nuclear fuel industry, the issues facing nuclear power, and resource demands of nuclear power. (JWR)

14849 RESOURCES FROM THE SEA USING NUCLEAR ENERGY. Hammond, R. P. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 20(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

14850 DUAL-PURPOSE NUCLEAR DESALTING PLANT USING A LOW TEMPERATURE EVAPORATOR. Jones, J. E. Jr.; Hise, E. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 20-21(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

Reactor Fuel Cycle Economics

Refer also to abstracts 14484 and 14571.

14851 NUCLEAR FUEL FINANCING. Bachert, R. P. (Commonwealth Edison Co., Chicago). Trans. Amer. Nucl. Soc.; 16: 165-166(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14852 FINANCING NUCLEAR FUEL. Jeffrey, K. (Union National Bank, Los Angeles). Trans. Amer. Nucl. Soc.; 16: 166 (Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14853 EVALUATION OF FUEL FINANCING ALTERNATIVES. Kupp, R. W. (S. M. Stoller Corp., New York). Trans. Amer. Nucl. Soc.; 16: 166-167(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14854 ACCOUNTING FOR OFF-BALANCE SHEET FINANCING. Payne, J. B. (Peet, Marwich, Hartford, CI). Trans. Amer. Nucl. Soc.; 16: 168(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14855 FUEL FINANCING: THE EVOLUTION OF A CONCEPT Macklin, L. (Gulf United Nuclear Fuels Corp., Elmsford, NY). Trans. Amer. Nucl. Soc.; 16: 168(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

14856 ECONOMIC ASPECTS OF THE UTILIZATION OF NATURAL VS DEPLETED URANIUM IN LMFBRs. Barthold, W. P. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 16: 169(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). CONF-730611-.

14857 PLUTONIUM INDIFFERENCE-VALUE SENSITIVITY FOR A B AND W PRESSURIZED WATER REACTOR. Wright, E. L.; Tulenko, J. S. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 16: 169-170(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

Reactor Licensing and Regulation

Refer also to abstracts 14426, 14602, 14603, and 14646-14648.

14858 (DOCKET-1151-63) ELK RIVER REACTOR. Status of Deactivated Reactor, February 1, 1973-May 1, 1973. (United Power Association, Elk River, Minn. (USA)). 6 Jun 1973. 16p. Dep. NTIS $3.00.

14859 (DOCKET-50003-183) INDIAN POINT STATION, UNIT 1. Environmental Report and Benefit Cost Analysis, Appendices. (Consolidated Edison Co. of New York, Inc., New York). Mar 1973. 350p. Dep. NTIS $19.50.

Appendices concerning permits, fish protection, effluent releases, environmental monitoring survey, cost expenditures of environmental studies, post-operation surveys, environmental and post-operation survey for radioactivity, and a letter from Westchester County Department of planning are presented. (FS)

14860 (DOCKET-50003-184) INDIAN POINT STATION, UNIT 1. Environmental Report and Benefit-Cost Analysis. (Consolidated Edison Co. of New York, Inc., New York). Jun 1973. 345p. Dep. NTIS $19.25.

The environmental effects of construction and operation of the Indian Point Unit No. 1 reactor facility are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation.

14861 (DOCKET-50003-185) INDIAN POINT STATION, UNIT 1. Petition for Full-Term Operating License, Amendment 6. (Consolidated Edison Co. of New York, Inc., New York). 13 Jul 1973. 64p. Dep. NTIS $5.25.

Responses to AEC questions on design bases, leakage measurements, valve leaks, biological shield corrosion, deformations and wire rupture of prestressed ring girders, control rod malfunction, high pressure boron addition system, power and reactivity anomolies, location of controls outside the control room, cooling pump operation, fuel storage facility drainage, and equipment in fuel storage area are provided. (FS)

14862 (DOCKET-50010-174) DRESDEN NUCLEAR POWER STATION, UNIT 1. Scram Setpoint Drift on Channel 5 High Neu-

tron Flux Sensor. (Commonwealth Edison Co., Morris, Ill. (USA)). 18 Jun 1973. 2p. Dep. NTIS $3.00.

14863 (DOCKET-50029-259) YANKEE NUCLEAR POWER STATION. Report on Effects of Piping System Break Outside Containment. (Yankee Atomic Electric Co., Rowe, Mass.). Jul 1973. 63p. Dep. NTIS $5.25.

14864 (DOCKET-50133-123) HUMBOLDT BAY POWER PLANT, UNIT 3. Failure of Cleanup Pump Motor. (Pacific Gas and Electric Co., San Francisco, Calif.). 18 Jun 1973. 2p. Dep. NTIS $3.00.

14865 (DOCKET-50155-158) BIG ROCK POINT NUCLEAR PLANT. Valve Wall Thickness Verification Program. (Consumers Power Co., Jackson, Mich.). 12 Jun 1973. 2p. Dep. NTIS $3.00.

14866 (DOCKET-50155-159) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Request for Change 38. (Consumers Power Co., Jackson, Mich.). 15 Jun 1973. 6p. Dep. NTIS $3.00.

Changes concerning frequency of valve testing, operational personnel requirements and operational procedure manuals are requested. (FS)

14867 (DOCKET-50155-160) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Request for Change No. 39. (Consumers Power Co., Jackson, Mich.). 29 Jun 1973. 71p. Dep. NTIS $5.75.

Changes are proposed on leakage from the 10 and 12 inch main steam lines and the 10 inch feedwater line, post operational inspections, and the frequency of inservice inspection of the main steam and feed water lines outside the containment. Two attachments "Effect of Compartment Pressurization Due to Pipe System Break Outside Containment" and "Evaluation of the Effects of Jet Thrust and Pipe Whip Due to Pipe System Break Outside Containment" are included. (FS)

14868 (DOCKET-50206-205) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications, Proposed Changes 20 and 21. (Southern California Edison Co., Rosemead, Calif.). 15 Jun 1973. 17p. Dep. NTIS $3.00.

Information on proposed changes to the technical specifications concerning the control group insertion limits and the core loading arrangement at the San Onofre Nuclear Generating Station, Unit 1, is presented. (JWR)

14869 (DOCKET-50206-206) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications, Proposed Changes 17, 18, and 19. (Southern California Edison Co., Rosemead, Calif.). 15 Jun 1973. 150p. (WCAP-2834(R1)). Dep. NTIS $9.50.

Information on proposed changes to the technical specifications for the San Onofre Nuclear Generating Station, Unit 1, is presented. The changes concern the inservice inspection of the reactor coolant system and rod cluster control assembly, the reactor vessel surveillance program, and the combined heatup, cooldown, and pressure limitations. (JWR)

14870 (DOCKET-50206-207) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Description and Safety Analysis Including Fuel Densification. (Westinghouse Electric Corp., Pittsburgh, Pa.). May 1973. 60p. (WCAP-8131). Dep. NTIS $5.00.

A description and safety analysis for Cycle 4 operation of San Onofre Nuclear Generating Station Unit 1 are presented. An evaluation of fuel densification is included. (JWR)

14871 (DOCKET-50213-208) HADDAM NECK PLANT, UNIT 1. Malfunction of a Reactor Containment Isolation Trip Valve. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 9 Jun 1973. 2p. Dep. NTIS $3.00.

14872 (DOCKET-50213-207) HADDAM NECK PLANT, UNIT 1. Amendment 16 to License Application, Part A, Technical Specifications. (Connecticut Yankee Atomic Power Co., Haddam). 3 Apr 1967. 127p. Dep. NTIS $8.50.

Technical specifications and bases concerning design features, safety limits and maximum settings, limiting conditions for operation, surveillance requirements, and administrative controls are presented. (FS)

14873 (DOCKET-50219-272) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Failure of Diesel Generator to Assume Load; Sample of Reactor Coolant Was Not Analyzed; Failure of Containment Spray System to Reset Automatically. (Jersey Central Power and Light Co., Morristown, N. J.). 18 Jun 1973. 6p. Dep. NTIS $3.00.

14874 (DOCKET-50219-273) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Electromatic Relief Valve Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 22 Jun 1973. 2p. Dep. NTIS $3.00.

14875 (DOCKET-50219-274) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). 1972. 235p. Dep. NTIS $13.75.

The environmental effects of construction and operation of the Oyster Creek Nuclear Generating Station are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

14876 (DOCKET-50220-145) NINE MILE POINT NUCLEAR STATION, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jul 1973. 192p. Dep. NTIS $11.75.

The environmental effects of construction and operation of the Nine Mile Point Nuclear Station Unit 1 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

14877 (DOCKET-50231-133) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Quarterly Environmental and Facility Radiation Survey. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jun 1973. 4p. Dep. NTIS $3.00.

14878 (DOCKET-50237-337) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1973. 271p. (DOCKET-50249-244). Dep. NTIS $15.75.

The environmental effects of construction and operation of the Dresden Nuclear Power Station Units 2 and 3 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

14879 (DOCKET-50237-347) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Organization of Licensing Documents. (Commonwealth Edison Co., Chicago, Ill.). 13 Jun 1973. 21p. (DOCKET-50249-241). Dep. NTIS $3.25.

Documents which form the basis of the license limitations for Dresden-2 and -3 Reactors are indexed and listed with the date of transmittal. Periodic revisions will be issued to keep the index current. (FS)

14880 (DOCKET-50244-172) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft Environmental Statement, Comments of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 21 Jun 1973. 4p. Dep. NTIS $3.00.

14881 (DOCKET-50245-232) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Reactor Containment Building Integrated Leak Rate Test. (Millstone Point Co., Hartford, Conn.). 12 Jun 1973. 123p. Dep. NTIS $8.25.

14882 (DOCKET-50245-233) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Special Report, Chloride Intrusion Incident. (Millstone Point Co., Hartford, Conn.). 29 Jun 1973. 38p. Dep. NTIS $4.00.

14883 (DOCKET-50247-121) INDIAN POINT NUCLEAR GENERATING UNIT 2. Technical Specifications, Flow Trip Settings out of Calibration. (Consolidated Edison Co. of New York, Inc., New York). 15 Jun 1973. 2p. Dep. NTIS $3.00.

14884 (DOCKET-50249-238) DRESDEN NUCLEAR POWER STATION, UNIT 3. Technical Specifications, Primary Containment Penetrations with Leakage. (Commonwealth Edison Co., Chicago, Ill.). 20 Jun 1973. 8p. Dep. NTIS $3.00.

14885 (DOCKET-50249-239) DRESDEN NUCLEAR POWER STATION, UNIT 3. Technical Specifications, Automatic Pressure Relief System Valve Failed. (Commonwealth Edison Co., Chicago, Ill.). 20 Jun 1973. 2p. Dep. NTIS $3.00.

14886 (DOCKET-50249-240) DRESDEN NUCLEAR POWER STATION, UNIT 3. Technical Specifications, Low Vacuum Scram Bypass Switches Drifted. (Commonwealth Edison Co., Chicago, Ill.). 22 Jun 1973. 2p. Dep. NTIS $3.00.

14887 (DOCKET-50249-242) DRESDEN NUCLEAR POWER STATION, UNIT 3. Failure of Low Pressure Coolant Injection Valve. (Commonwealth Edison Co., Chicago, Ill.). 14 Jun 1973. 2p. Dep. NTIS $3.00.

14888 (DOCKET-50249-243) DRESDEN NUCLEAR POWER STATION, UNIT 3. High Pressure Coolant Injection Steam Supply Valve Failed to Open Completely. (Commonwealth Edison Co., Chicago, Ill.). 14 Jun 1973. 2p. Dep. NTIS $3.00.

14889 (DOCKET-50250-135) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence 3-73-4: Low Boron Concentration in 3C Accumulator. (Florida Power and Light Co.). 23 Jun 1973. 6p. Dep. NTIS $3.00.

14890 (DOCKET-50250-136) TURKEY POINT PLANT, UNITS 3 AND 4. Technical Specifications, Proposed Changes. (Florida Power and Light Co.). 18 Jun 1973. 16p. (DOCKET-50251-123). Dep. NTIS $3.00.

Changes in words and personnel titles in the Technical Specifications are proposed. (FS)

14891 (DOCKET-50250-137) TURKEY POINT PLANT, UNITS 3 AND 4. Fuel Densification, Low Pressure Analysis. (Florida Power and Light Co.). 5 Jul 1973. 39p. (DOCKET-50251-126; WCAP-8137). Dep. NTIS $4.00.

14892 (DOCKET-50251-124) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence No. 4-73-6, Rod Control Cluster H-8 Stuck. (Florida Power and Light Co.). 15 Jun 1973. 2p. Dep. NTIS $3.00.

14893 (DOCKET-50254-206) QUAD-CITIES STATION, UNITS 1 AND 2. Proposed National Pollutant Discharge Elimination System Permit. (Commonwealth Edison Co., Cordova, Ill.). 21 May 1973. 9p. (DOCKET-50265-198). Dep. NTIS $3.00.

14894 (DOCKET-50254-213) QUAD-CITIES STATION, UNITS 1 AND 2. Technical Specifications, Proposed Changes. (Commonwealth Edison Co., Chicago, Ill). 14 Jun 1973. 11p. (DOCKET-50265-209). Dep. NTIS $3.00.

Changes concerning scram time testing schedule and a modification of the control-rod drive system to allow shorter control-rod drive scram times are proposed. (FS)

14895 (DOCKET-50254-214) QUAD-CITIES STATION, UNIT 1. Relief Valve on Standby Liquid Control System Actuated. (Commonwealth Edison Co., Cordova, Ill.). 12 Jun 1973. 5p. Dep. NTIS $3.00.

14896 (DOCKET-50254-215) QUAD-CITIES STATION, UNIT 1. Reload Fuel. (Commonwealth Edison Co., Chicago, Ill.). 15 Jun 1973. 51p. Dep. NTIS $4.75.

14897 (DOCKET-50261-183) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of Governor of South Carolina; South Carolina State Board of Health; South Carolina State Highway Department; South Carolina State Commission of Forestry; South Carolina State Development Board; South Carolina Department of Archives and History. (Carolina Power and Light Co., Raleigh, N. C.). 6 Jun 1973. 6p. Dep. NTIS $3.00.

14898 (DOCKET-50261-188) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of Carolina Power and Light Company; Darlington County Water and Sewer Authority; Darlington County Development Board. (Carolina Power and Light Co., Raleigh, N. C.; Darlington County Water and Sewer Authority, S. C. (USA); Darlington County Development Board, S. C. (USA)). 11 Jun 1973. 9p. Dep. NTIS $3.00.

14899 (DOCKET-50266-115) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. License Application, Amendment 13. (Wisconsin Electric Power Co., Milwaukee; Wisconsin Michigan Power Co., Appleton, Wis.). 8 Jun 1973. 233p. (DOCKET-50301-99). Dep. NTIS $13.75.

Changes concerning the officers and directors of the Point Beach Plant, results of rerouting the hot leg injection of the ECCS to the core deluge nozzles, failure mechanism of the steam generator tubes, personnel changes in operation, additional environmental radiation and particulate sampling stations, and typographical errors are presented. (FS)

14900 (DOCKET-50271-192) VERMONT YANKEE NUCLEAR POWER STATION. Treatment of Cooling Water with Sodium Hypochlorite. (Vermont Yankee Nuclear Power Corp., Rutland). 19 Jun 1973. 29p. Dep. NTIS $3.50.

14901 (DOCKET-50272-73) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, Amendment 23. (Public Service Electric and Gas Co., Newark, N. J.). 2 Jul 1973. 164p. (DOCKET-50311-69). Dep. NTIS $10.35.

Revisions to the general design criteria, site and environment, reactor coolant system, electrical system, waste disposal and radiation protection, and conduct of operations are presented. Responses to AEC questions on the above and also on safety analysis are also given. (FS)

14902 (DOCKET-50281-115) SURRY POWER STATION, UNIT 2. Request for a Thirty-Day Extension on Submittal of Startup Report. (Virginia Electric and Power Co., Richmond). 21 Jun 1973. 1p. Dep. NTIS $3.00.

14903 (DOCKET-50282-125) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050-282/73-12. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 5 Jun 1973. 11p. Dep. NTIS $3.00.

14904 (DOCKET-50282-126) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Interim Report of Disc Replacement in Main Steam Isolation and Check Valves. (Northern States Power Co., Minneapolis, Minn.). 11 Jun 1973. 2p. (DOCKET-50306-116). Dep. NTIS $3.00.

14905 (DOCKET-50282-129) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 35. (Northern States Power Co., Minneapolis, Minn.). 22 Jun 1973. 38p. (DOCKET-50306-117). Dep. NTIS $4.00.

Revisions on site characteristics, design criteria for grid assemblies, and readout of condensate flow measuring devices are presented. Responses to questions on feedwater line rupture, main steam line rupture and ventilation in the auxiliary building are included. (FS)

14906 (DOCKET-50282-130) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Minnesota Pollution Control Agency Certification. (Northern States Power Co., Minneapolis, Minn.). 6 Jul 1973. 31p. (DOCKET-50306-118). Dep. NTIS $3.75.

14907 (DOCKET-50285-99) FORT CALHOUN STATION, UNIT 1. Pre-operational Environmental Radioactivity Surveillance Program, First Quarter, 1973. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 29 Jun 1973. 29p. Dep. NTIS $3.50.

For Omaha Public Power District, NE.

14908 (DOCKET-50289-103) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Fuel Densification Effects. (Metropolitan Edison Co., Reading, PA). 28 Dec 1972. 4p. (DOCKET-50320-48). Dep. NTIS $3.00.

14909 (DOCKET-50289-105) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Reactor Vessel Internals Thermal Shield Scratches. (Metropolitan Edison Co., Reading, PA). 4 Jun 1973. 5p. Dep. NTIS $3.00.

14910 (DOCKET-50289-106) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Major Component Weld Records. (Metropolitan Edison Co., Reading, PA). 13 Jun 1973. 2p. (DOCKET-50320-49). Dep. NTIS $3.00.

14911 (DOCKET-50293-146) PILGRIM NUCLEAR POWER STATION. Inspection Report No. 50-293/73-02. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 4 Jun 1973. 30p. Dep. NTIS $3.50.

14912 (DOCKET-50293-147) PILGRIM NUCLEAR POWER STATION. AO-73-18, Barksdale Pressure Switch out of Calibration; AO-73-19, Fenwal Temperature Switches out of Calibration. (Boston Edison Co., Mass). 19 Jun 1973. 5p. Dep. NTIS $3.00.

14913 (DOCKET-50293-149) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence 73-20: Malfunction of Miniature Actuation Switch. (Boston Edison Co., Mass.). 27 Jun 1973. 1p. Dep. NTIS $3.00.

14914 (DOCKET-50295-127) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Leaking Weld. (Commonwealth

Edison Co., Zion, Ill. (USA)). 9 Jun 1973. 2p. Dep. NTIS $3.00.

14915 (DOCKET-50295-137) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Leak in Weld on Pump Discharge Relief Valve. (Commonwealth Edison Co., Zion, Ill. (USA)). 20 Jun 1973. 2p. Dep. NTIS $3.00.

14916 (DOCKET-50295-138) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 29. (Commonwealth Edison Co., Chicago, Ill.). 21 Jun 1973. 21p. (DOCKET-50304-104). Dep. NTIS $3.25.

Requested additional information on the environmental qualifications of components located in the auxiliary building subject to the effects of a high energy pipe break outside containment at the Zion Station Nuclear Power Plant, Units 1 and 2, is presented. The components include instrumentation and controls, charging pump motors, remote shutdown panels, and auxiliary feedwater pump motors. (JWR)

14917 (DOCKET-50296-86) BROWNS FERRY NUCLEAR POWER STATION, UNIT 3. Vendor Inspection Report No. 50-296/73-1 (999-34). (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 8 Jun 1973. 9p. Dep. NTIS $3.00.

14918 (DOCKET-50298-81) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 25. (Nebraska Public Power District, Columbus). 8 Jun 1973. 95p. Dep. NTIS $6.75.

Information concerning the effects of a piping system break outside the primary containment is presented. (FS)

14919 (DOCKET-50298-82) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 26. (Nebraska Public Power District, Columbus). 9 Jul 1973. 51p. Dep. NTIS $4.75.

Responses to questions on flux asymmetry, safety interlocks for the containment, and modifications to the reactor building crane are presented. (FS)

14920 (DOCKET-50301-100) POINT BEACH NUCLEAR PLANT, UNIT 2. Alternate Techniques to Reduce Discharges of Demineralizer Regenerant Waste to Lake Michigan. (Wisconsin Electric Power Co., Milwaukee). 29 Jun 1973. 37p. Dep. NTIS $4.00.

14921 (DOCKET-50302-77) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. NELIA Policy NF-195. (Nuclear Energy Liability Insurance Association, New York (USA)). 29 May 1973. 1p. Dep. NTIS $3.00.

14922 (DOCKET-50305-87) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendent 30. (Wisconsin Public Service Corp., Green Bay). 15 Jun 1973. 35p. Dep. NTIS $3.75.

The "Final Environmental Technical Specifications and Bases" is presented and noted as Appendix B of the Technical Specifications. (FS)

14923 (DOCKET-50312-80) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment 23. (Sacramento Municipal Utility District, Calif.). 22 Jun 1973. 177p. Dep. NTIS $11.00.

The design bases earthquake values are changed to 0.25 g horizontal and 0.17 g vertical and changes are also made for pipe break effects. Questions on peak core cladding temperature in the worst case of coolant leg break and on consequences of a break in a core flooding line are answered. (FS)

14924 (DOCKET-50312-81) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 8 Jun 1973. 189p. Dep. NTIS $11.50.

An evaluation which includes a technical review of the site, criteria, design basis accidents, radioactive releases, organization, and financial qualifications is reported. (FS)

14925 (DOCKET-50313-85) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 39. (Arkansas Power and Light Co., Little Rock). 20 Jun 1973. 70p. Dep. NTIS $5.50.

Changes concerning the activities of the emergency coordinator, the emergency organization, evacuation in an emergency, personnel accountability and conduct of construction personnel in an emergency are proposed. (FS)

14926 (DOCKET-50313-86) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 38. (Arkansas Power and Light Co., Little Rock). 15 Jun 1973. 149p. Dep. NTIS $9.50.

Changes are proposed concerning personnel, tendon surveillance, isolation valves in the cooling system, power tilt, fuel handling, diesel generators, control rod drives, the emergency cooling pond, seismic forces, and pipe breaks. (FS)

14927 (DOCKET-50315-127) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Fuel Densification. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jun 1973. 90p. (DOCKET-50316-124; WCAP-8165). Dep. NTIS $6.50.

14928 (DOCKET-50321-84) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Inspection Report 50-321/73-4. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 21 Jun 1973. 18p. Dep. NTIS $3.00.

14929 (DOCKET-50321-85) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 35. (Georgia Power Co., Atlanta). 27 Jun 1973. 94p. Dep. NTIS $6.75.

Revisions are presented for the radiation monitoring systems for the air ejector off-gas, the off-gas vent pipe and the process liquids. (FS)

14930 (DOCKET-50324-84) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 19. (Carolina Power and Light Co., Raleigh, N. C.). 3 Jul 1973. 394p. (DOCKET-50325-84). Dep. NTIS $21.75.

Responses to AEC questions on the plant description, site characteristics, reactor, reactor cooling system, engineered safety features, instrumentation and control, auxiliary power, steam and power conversion system, conduct of operations, and initial tests and programs are presented. (FS)

14931 (DOCKET-50324-85) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Environmental Report, Amendment 7. (Carolina Power and Light Co., Raleigh, N. C.). 9 Jul 1973. 62p. DOCKET-50325-85). Dep. NTIS $5.25.

Revisions are presented for the site and plant, environmental impact, alternate proposals, environmental effects which can not be avoided, and cost benefit analysis. (FS)

14932 (DOCKET-50329-41) MIDLAND PLANT, UNITS 1 AND 2. Application for Construction Permit and Operating License, Amendment 10. (Consumers Power Co., Jackson, Mich.). 28 Apr 1973. 285p. (DOCKET-50330-40). Dep. NTIS $16.25.

Additional information is presented concerning hydrology, seismic design, on-site meteorological monitoring, and salt and brine well operations. (FS)

14933 (DOCKET-50331-95) DUANE ARNOLD ENERGY CENTER. Certification of State of Iowa, Department of Environmental Quality. (Iowa Electric Light and Power Co., Cedar Rapids). 27 Apr 1973. 3p. Dep. NTIS $3.00.

14934 (DOCKET-50333-99) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Inspection Report No. 50-333/73-04. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Apr 1973. 13p. Dep. NTIS $3.00.

14935 (DOCKET-50333-100) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Supplement 22. (Power Authority of the State of New York). 21 Jun 1973. 82p. Dep. NTIS $6.25.

Changes are proposed on the rod sequence control system, rod drop accident, 115 kV system, personnel training, supervisory personnel, plant procedures, and industrial security. (FS)

14936 (DOCKET-50333-101) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 24, Supplement 23. (Power Authority of the State of New York). 28 Jun 1973. 204p. Dep. NTIS $12.25.

Changes concerning the reactor low water level scram, turbine stop valve closure scram, pressure and level alarms, control rod coupling to control rod drive, reactivity anomalies, RHR system, pressurization temperature, pressure suppression chamber, high efficiency particulate filters, environmental monitoring, diesel generator, station batteries, and operations reports are proposed. A special report "Effects of a High Energy Piping Break Outside the Primary Containment" is included. (FS)

14937 (DOCKET-50334-62) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of Assistant Secretary of Commerce. (Office of the Assistant Secretary of Commerce, Washington, D. C. (USA)). 2 May 1973. 1p. Dep. NTIS $3.00.

14938 (DOCKET-50334-79) BEAVER VALLEY POWER STATION, UNIT 1. Final Safety Analysis Report, Amendment 3. (Duquesne Light Co., Pittsburgh, Pa.). 26 Jun 1973. 338p. Dep. NTIS $19.00.

Changes concerning engineered safety features, radioactive waste management, and initial tests and programs are presented. Responses to AEC questions on design criteria for structures, components, and systems; and auxiliary power are given. (FS)

14939 (DOCKET-50336-64) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Stress Cone Failures. (Millstone Point Co., Hartford, Conn.). 6 Jun 1973. 4p. Dep. NTIS $3.00.

14940 (DOCKET-50336-65) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Final Safety Analysis Report, Amendment 16. (Millstone Point Co., Hartford, Conn.). 27 Jun 1973. 329p. Dep. NTIS $18.50.

Changes concerning pipe-whip protection, pipe ruptures, safety injection pump testing, liquid radiation monitors, process instrument design, area radiation monitoring, liquid radiation monitors, radioactive waste management and the quality assurance for the preoperational start-up test program are presented. Questions on closing times for isolation valves, containment waterproofing, seismic effects on battery racks, relays, analysis of diesel generators, fuel storage racks, and service water pump motors are answered. (FS)

14941 (DOCKET-50336-66) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Final Safety Analysis Report, Amendment 17. (Millstone Point Co., Hartford, Conn.). 2 Jul 1973. 120p. Dep. NTIS $8.00.

The amendment consists of a report entitled "Millstone Unit No. 2, Analysis of a Postulated Pipe Rupture Outside Containment" which describes the criteria, high energy fluid systems, procedures for placing the reactor in a safe shutdown condition, analysis and effects of the rupture, and concludes that the consequences of the rupture will be mitigated and safe shutdown is insured. (FS)

14942 (DOCKET-50338-77) NORTH ANNA POWER STATION, UNITS 1 AND 2. Vendor Inspection Report Nos. 50-338/73-5 and 50-339/73-5 (999-39). (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 27 Jun 1973. 9p. (DOCKET-50339-75). Dep. NTIS $3.00.

14943 (DOCKET-50338-78) NORTH ANNA POWER STATION, UNITS 1 AND 2. License Application, Amendment 19. (Virginia Electric and Power Co., Richmond). 11 Jul 1973. 135p. (DOCKET-50339-76). Dep. NTIS $8.75.

Revisions for the plant description, site, instrumentation and controls, conduct of operations, and technical specifications and bases, are included. Responses to AEC questions are presented on the site; design and criteria of structures, components, and systems; reactor control systems; engineered safety features; radiation protection; conduct of operations; technical specifications and bases; and quality assurance. (FS)

14944 (DOCKET-50341-60) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. RHR Service Water Pond Design. (Detroit Edison Co., Mich.). 11 Jun 1973. 4p. Dep. NTIS $3.00.

14945 (DOCKET-50344-65) TROJAN NUCLEAR PLANT. Terrestrial Ecology, Baseline Study. (Battelle Pacific Northwest Labs., Richland, Wash.). Mar 1973. 71p. (PGE-1003). Dep. NTIS $5.75.

For Portland General Electric Co., OR.

A record is provided of the kinds, relative abundance, and behavioral characteristics of the animals and plants living in the environs of the Trojan facility. The major part of the survey is concerned with terrestrial ecology and the smaller portion is concerned with aquatic ecology. (FS)

14946 (DOCKET-50348-62) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Inspection Report Nos. 50-348/73-2 and 50-364/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 26 Jun 1973. 20p. (DOCKET-50364-50). Dep. NTIS $3.00.

14947 (DOCKET-50363-52) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Inspection Report No. 50-363/73-02. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 15 May 1973. 8p. Dep. NTIS $3.00.

14948 (DOCKET-50367-42) BAILLY GENERATING STATION, NUCLEAR 1. Inspection Report No. 50-367/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 5 Jun 1973. 7p. Dep. NTIS $3.00.

14949 (DOCKET-50373-38) LA SALLE COUNTY STATION, UNITS 1 AND 2. Development Plan for Land and Water Resources of the La Salle County Cooling Lake, Comments of Illinois Department of Conservation and Illinois Natural History Survey. (Illinois Dept. of Conservation, Springfield (USA); Illinois Natural History Survey, Urbana). 21 May 1973. 6p. (DOCKET-50374-38). Dep. NTIS $3.00.

14950 (DOCKET-50373-39) LA SALLE COUNTY STATION, UNITS 1 AND 2. Lake Management Program. (Commonwealth Edison Co., Chicago, Ill.). 13 Jun 1973. 1p. (DOCKET-50374-39). Dep. NTIS $3.00.

14951 (DOCKET-50373-40) LA SALLE COUNTY STATION, UNITS 1 AND 2. Comments on Combustion Engineering Report on Cooling Lake by Illinois Natural History Survey. (Commonwealth Edison Co., Chicago, Ill.). 12 Jun 1973. 3p. (DOCKET-50374-40). Dep. NTIS $3.00.

14952 (DOCKET-50376-39) AGUIRRE NUCLEAR PLANT, UNIT 1. Inspection Report 50-376/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 27 Jun 1973. 11p. Dep. NTIS $3.00.

14953 (DOCKET-50382-66) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Inspection Report 50-382/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 26 Jun 1973. 10p. Dep. NTIS $3.00.

14954 (DOCKET-50387-41) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Federal Power Commission. (Pennsylvania Power and Light Co., Allentown). 21 Jun 1973. 4p. (DOCKET-50388-40). Dep. NTIS $3.00.

14955 (DOCKET-50404-52) NORTH ANNA POWER STATION, UNITS 3 AND 4. Vendor Inspection Report Nos. 50-404/73-2 and 50-405/73-2 (999-34). (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 27 Jun 1973. 14p. (DOCKET-50405-51). Dep. NTIS $3.00.

14956 (DOCKET-50412-15) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement, Comments of the Assistant Secretary of Commerce. (Office of the Assistant Secretary of Commerce, Washington, D. C. (USA)). 23 May 1973. 5p. Dep. NTIS $3.00.

14957 (DOCKET-50412-22) BEAVER VALLEY POWER STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 6. (Duquesne Light Co., Pittsburgh, Pa.). 26 Jun 1973. 543p. Dep. NTIS $29.25.

Revisions are presented for the plant description; design criteria for structures, components, equipment, and systems; radioactive waste management; and test programs. Responses are made for AEC questions on the reactor, radioactive waste management, tests and operation, design criteria, engineered safety features, the site, and accident analysis. (FS)

14958 (DOCKET-50412-23) BEAVER VALLEY POWER STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 7. (Duquesne Light Co., Pittsburgh, Pa.). 2 Jul 1973. 319p. Dep. NTIS $18.00.

Answers are given to questions on low flow, site drainage, seismic design, soil structure interactions, decoupling criteria, 1.3 factor, seismic piping design, dynamic analysis, code case interpretation, code class 2 and 3 components, allowable stress, fracture prevention, sensitized austenitic stainless steel, pressure relief safety, vegetable sampling, milk analysis, and crew size. (FS)

14959 (DOCKET-50413-24) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Assistant Secretary of Commerce. (Office of the Assistant Secretary of Commerce, Washington, D. C. (USA)). 12 Jun 1973. 2p. (DOCKET-50414-24). Dep. NTIS $3.00.

14960 (DOCKET-50413-25) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Catawba Regional Planning Council. (Catawba Regional Planning Council. Rock Hill, S. C. (USA)). 5 Jun 1973. 1p. (DOCKET-50414-25). Dep. NTIS $3.00.

14961 (DOCKET-50413-27) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments by State of South Carolina Water Resources Commission; South Carolina State Board of Health; South Carolina Department of Archives and History; South Carolina State Highway Department; South Carolina State Commission of Forestry; South Carolina State Development Board. (Duke Power Co., Charlotte, N. C.). 7 Jun 1973. 12p. (DOCKET-50414-27). Dep. NTIS $3.00.

14962 (DOCKET-50413-28) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Department of Transportation, United States Coast Guard. (Duke Power Co., Charlotte, N. C.). 13 Jun 1973. 1p. (DOCKET-50414-28). Dep. NTIS $3.00.

14963 (DOCKET-50413-29) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments by Forest Service. (Duke Power Co., Charlotte, N. C.). 14 Jun 1973. 2p. (DOCKET-50414-29). Dep. NTIS $3.00.

14964 (DOCKET-50413-30) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 9, Questions and Answers. (Duke Power Co., Charlotte, N. C.). 22 Jun 1973. 370p. (DOCKET-50414-30). Dep. NTIS $20.50.

Changes concerned with effects of seismic failure of Cowens Ford Dam; containment jet impingement from pipe rupture; containment intake screens, sump and spray systems; air return fans; blowdown rate; monitoring exhaust air; main stream isolation valves, solid waste system and the quality assurance program are presented. Questions are answered on the population within a 10 mile radius, site drainage, SNSW dam and pond, flooding protection, diesel generator oil tanks, and the foundations for water storage tanks. (FS)

14965 (DOCKET-50413-31) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Comments on Draft Environmental Statement. (Duke Power Co., Charlotte, N. C.). 25 Jun 1973. 6p. (DOCKET-50414-31). Dep. NTIS $3.00.

14966 (DOCKET-50413-32) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. License Application, Amendment 3. (Duke Power Co., Charlotte, N. C.). 2 Jul 1973. 53p. (DOCKET-50414-32). Dep. NTIS $4.75.

Financial qualifications of the Duke Power Company are presented in a financial statement and the current annual report to shareholders for the year 1971. (FS)

14967 (DOCKET-50413-33) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 10. (Duke Power Co., Charlotte, N. C.). 2 Jul 1973. 109p. (DOCKET-50414-33). Dep. NTIS $7.50.

Proposals concerning the SNSW dam and pond, seismic instruments and data, mechanical penetrations, annulus ventilation, environmental consequences of a LOCA, and acceptance criteria are presented. Questions on seismic analysis and short term blowdown are answered. (FS)

14968 (DOCKET-50416-26) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Assistant Secretary of Commerce. (Office of the Assistant Secretary of Commerce, Washington, D. C. (USA)). 7 Jun 1973. 2p. (DOCKET-50417-26). Dep. NTIS $3.00.

14969 (DOCKET-50416-30) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of State of Mississippi, Department of Archives and History, Forestry Commission, Geological Economic Topographical Survey, State Highway Department, and Board of Water Commissioners. (Mississippi Power and Light Co., Jackson (USA)). Jun 1973. 8p. (DOCKET-50417-30). Dep. NTIS $3.00.

14970 (DOCKET-50416-31) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of State of Mississippi, Department of Archives and History. (Mississippi Dept. of Archives and History, Jackson (USA)). 8 May 1973. 2p. (DOCKET-50417-31). Dep. NTIS $3.00.

14971 (DOCKET-50416-33) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Environmental Report, Amendment 3. (Mississippi Power and Light Co., Jackson (USA)). 15 Jun 1973. 13p. (DOCKET-50417-33). Dep. NTIS $3.00.

Information consisting of a BWR flow diagram and schematics of water use for full-power operation, the circulating water system, and the standby water system is presented. (FS)

14972 (DOCKET-50416-34) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 21 Jun 1973. 5p. (DOCKET-50417-34). Dep. NTIS $3.00.

14973 (DOCKET-50416-35) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Forest Service and Soil Conservation Service. (Department of Agriculture, Washington, D. C.). 19 Jun 1973. 6p. (DOCKET-50417-35). Dep. NTIS $3.00.

14974 (DOCKET-50416-36) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Mississippi State Board of Health, Mississippi Game and Fish Commission, and Mississippi Board of Water Commissioners. (Mississippi Power and Light Co., Jackson (USA)). 15 Jun 1973. 6p. (DOCKET-50417-36). Dep. NTIS $3.00.

14975 (DOCKET-50416-37) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 8. (Mississippi Power and Light Co., Jackson (USA)). 15 Jun 1973. 205p. (DOCKET-50417-37). Dep. NTIS $12.25.

Changes are proposed for electrical and instrumentation auxiliaries including diesel generators, on site emergency electric systems, the high pressure core spray, steam leads from the turbine control valve, examination procedures and acceptance standards, valves, control rod drive water lines, reactor circulation pump and motor, combustible gas control, hydrogen purge system, and the radioactivity released from failed equipment. Answers are given for questions on the control rod drive hydraulic system, high pressure core spray, ASME Boiler and Pressure Vessel Code, power distribution, and response to transients. (FS)

14976 (DOCKET-50416-38) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Response to AEC Comments. (Mississippi Power and Light Co., Jackson (USA)). 19 Jun 1973. 4p. (DOCKET-50417-38). Dep. NTIS $3.00.

14977 (DOCKET-50416-39) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Plant, Amendment 9. (Mississippi Power and Light Co., Jackson (USA)). 28 Jun 1973. 291p. (DOCKET-50417-39). Dep. NTIS $16.75.

Changes concerning wind calculations, inlet valves of the hydrogen mixing system, ECCS pumps, RHR system, automatic or manual closure of motor-operated valves, ventilating in emergency switchgear and battery rooms, the liquid radwaste system and performance tests are proposed. Questions are answered on past accident combustible gas control, containment and drywell ventilation and cooling systems, and line leakage. (FS)

14978 (DOCKET-50423-16) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Inspection Report No. 423/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 10 May 1973. 12p. Dep. NTIS $3.00.

14979 (DOCKET-50423-17) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Draft Environmental Statement. (Directorate of Licensing (AEC), WASHINGTON, D. C.). Jun 1973. 240p. Dep. NTIS $14.00.

The environmental effects of construction and operation of the Millstone Nuclear Power Station Unit 3 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

14980 (DOCKET-50423-18) MILLSTONE NUCLEAR POWER STATION, UNIT 3. License Application, Amendment 4. (Millstone Point Co., Hartford, Conn.). 11 Jul 1973. 644p. Dep. NTIS $34.25.

Changes concerning the containment enclosure building, modification of the leak collection system, revisions to the radioactive gaseous waste treatment system and the radioactive solid waste treatment system, and miscellaneous revisions are proposed. Questions are answered on controlling radioactivity, rail traffic on Penn Central tracks, seasonal recreational use of exclusion area, design basis accident radioactivity releases, shipping in Long Island Sound, take-off and landings at New London Airport, and the frequency distribution of wind speed and direction. (FS)

14981 (DOCKET-50423-19) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, License Application, Amendment 5. (Millstone Point Co., Hartford, Conn.). 13 Jul 1973. 281p. Dep. NTIS $16.25.

Responses to AEC questions on site characteristics, design criteria for components and systems, and radioactive waste management are presented. (FS)

14982 (DOCKET-50424-17) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Inspection Reports Nos. 50-424/73-1, 50-425/73-1, 50-426/73-1, 50-427/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 21 Jun 1973. 12p. (DOCKET-50425-17; DOCKET-50426-17; DOCKET-50427-17). Dep. NTIS $3.00.

14983 (DOCKET-50424-18) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 3. (Georgia Power Co., Atlanta). 3 Jul 1973. 606p. (DOCKET-50425-18; DOCKET-50426-18; DOCKET-50427-18). Dep. NTIS $32.50.

Responses to AEC questions on site characteristics, design criteria for structures and systems, engineered safety features, the steam and power conversion system, radioactive waste management, and conduct of operations are presented. (FS)

14984 (DOCKET-50434-10) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 1. (Virginia Electric and Power Co., Richmond). 18 Jun 1973. 704p. (DOCKET-50435-10). Dep. NTIS $37.25.

Revised and requested data are presented on: site characteristics; design criteria for structures, components, and systems; reactor; reactor cooling system; engineered safety features; instrumentation and control; electric power; auxiliary power; steam and power conversion system, radioactive waste management, radiation protection, conduct of operations; accident analysis; technical specifications and bases; and quality assurance. (FS)

14985 (DOCKET-50434-11) SURRY POWER STATION, UNITS 3 AND 4. PSAR License Application, Amendment 2. (Virginia Electric and Power Co., Richmond). 10 Jul 1973. 167p. (DOCKET-50435-11). Dep. NTIS $10.50.

Changes are proposed for wind and tornado loadings; the computer program for stress analysis of the containment liner; testing reinforcement bars for concrete structures; control room design; maximum expected activity in waste disposal system with steam generator leakage; and structures, components, and systems responsibilities. (FS)

14986 (DOCKET-50438-3) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement, Volume 1. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 389p. (DOCKET-50439-3). Dep. NTIS $21.50.

The environmental effects of construction and operation of the Bellefonte Nuclear Plant, Units 1 and 2, are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (JWR)

14987 (DOCKET-50438-8) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 4. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 531p. (Docket-50439-8). Dep. NTIS $28.75.

Information is presented on the reactor cooling system, engineered safety features, instrumentation, control system, and electric power system at the Bellefonte Nuclear Plant, Units 1 and 2. (JWR)

14988 (DOCKET-50438-10) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 6. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 549p. (Docket-50439-10). Dep. NTIS $29.50.

The Bellefonte plant shielding, ventilation, health physics program, radiation protection, organization, training, review and audit procedures, records, reporting, industrial security, testing procedures, preoperational and startup testing, accident analysis, technical specifications and quality assurance are described. (FS)

14989 (DOCKET-50440-1) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Application for Licenses. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 165p. (DOCKET-50441-1). Dep. NTIS $10.25.

14990 (DOCKET-50440-5) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 3. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 781p. (DOCKET-50441-5). Dep. NTIS $41.25.

The appendices for the Perry facility site characteristics including meteorological, wind and stability, and average temperature summaries; geology; numerical prediction of storm surge in Lake Erie; seismicity analysis and geophysical investigation; foundation design analysis; cooling and emergency service water tunnels; and boring logs are presented. (FS)

14991 (DOCKET-50440-6) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 4. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 460p. (DOCKET-50441-6). Dep. NTIS $25.00.

The design of structures, components, equipment, and systems for the Perry facility including wind and tornado loading, flooding, missile protection, protection associated with pipe rupture, seismic design of mechanical systems and components, seismic design of instrumentation and electrical equipment and environmental design of mechanical and electrical equipment are described. (FS)

14992 (DOCKET-50440-7) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 5. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 450p. (DOCKET-50441-7). Dep. NTIS $24.50.

The Perry facility reactors, coolant systems and connected systems including the thermal hydraulic system, reactor vessel and appurtenances, neutron monitoring system, and reactor vessel instrumentation are described. (FS)

14993 (DOCKET-50440-8) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 6. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 497p. (DOCKET-50441-8). Dep. NTIS $27.00.

Engineered safety features of the containment, ECCS, habitability systems, overpressurization, main steam line valves and flow restrictors, control-rod drive supports and limiters, the standby liquid control system, and instrumentation and control systems, including identification of safety related systems and criteria and reactor trip systems, are described. (FS)

14994 (DOCKET-50440-9) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 7. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 475p. (DOCKET-50441-9). Dep. NTIS $25.75.

Engineered safety systems, systems required for safe shutdown, safety-related display systems, all other instruments required for safety, control systems not required for safety and onsite and offsite electric power systems are presented. (FS)

14995 (DOCKET-50440-10) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 8. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 232p. (DOCKET-50441-10). Dep. NTIS $13.75.

Auxiliary systems including fuel storage and handling, water, air conditioning, heating, cooling, ventilation, fire protection, communications, lighting, and systems for the diesel generator such as fuel oil, cooling water, starting air, and lubrication are presented. Steam and power conversion systems including the turbine generator, main steam supply, main condensate, turbine gland and bypass, circulating water, and condensate polishing and feedwater are described. (FS)

14996 (DOCKET-50440-11) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 9. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 534p. (DOCKET-50441-11). Dep. NTIS $28.75.

Perry facility radioactive waste management, radiation protection, conduct of operations, initial tests and operation, and accident analyses are presented. (FS)

14997 (DOCKET-50440-12) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 10. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 416p. (DOCKET-50441-12). Dep. NTIS $23.00.

The Perry facility accident analysis, technical specifications and quality assurance program are presented. (FS)

14998 (DOCKET-50440-13) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 1. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 420p. (DOCKET-50441-13). Dep. NTIS $23.00.

The environmental effects of construction and operation of the Perry facility are examined. The requirement for power and consequences of delay in obtaining the power are explained. The site location, including population surveys, regional historic and natural landmarks, geology, hydrology and meteorology are described. (FS)

14999 (DOCKET-50440-14) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 2. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 440p. (DOCKET-50441-14). Dep. NTIS $24.25.

The environmental effects of construction and operation of the Perry facility are examined. Descriptions of the ecology of the site and of the plant including the external appearance, the reactor and steam-electric system, water use, the heat dissipation system, radwaste system, chemical and biocide system, sanitary and other wastes, radioactive materials inventory, and transmission line facilities are included. (FS)

15000 (DOCKET-50440-15) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 3. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 447p. (DOCKET-50441-15). Dep. NTIS $24.50.

The environmental effects of the construction and operation of the Perry facility are examined including heat dissipation, impact on man and biota, effects of chemical and biocide discharges,

effects on sanitary and other waste discharges, and the effects of operation and maintenance on the power transmission system. (FS)

15001 (DOCKET-50440-16) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Environmental Report, Construction Permit Stage, Volume 4. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 509p. (DOCKET-50441-16). Dep. NTIS $27.50.

In the examination of the environmental effects of the construction and operation of the Perry facility, the effluent and environmental measurements and monitoring, effects of accidents on the environment, economic and social effects of plant construction and operation, consideration of alternate sources and sites, plant design alternatives, benefit-cost analysis, and environmental approvals and consultation are described. (FS)

15002 (RDT-INDEX-5-73) INDEX OF RDT STANDARDS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 8 Jun 1973. 43p. RSO.

15003 (TID-3324-R1) TITLE LISTING OF CIVILIAN POWER REACTOR DOCKET LITERATURE IN NUCLEAR SCIENCE ABSTRACTS. Volumes 21-26(1967-1972). (Technical Information Center (AEC), Oak Ridge, Tenn.). Apr 1973. 488p. Dep. NTIS $10.60.

15004 LICENSING AND THE ROLE OF STANDARDS AND STANDARDIZATION. Minogue, R. B. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., 16: 23(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15005 ROLE OF STANDARDS AND STANDARDIZATION IN LICENSING. Minogue, R. B. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 16: 223-224(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15006 REFLECTIONS ON NUCLEAR PLANT LICENSING. Wofford, A. W. (Long Island Lighting Co., Hicksville, NJ). Trans. Amer. Nucl. Soc.; 16: 230(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15007 LICENSING: THE VENDOR'S PERSPECTIVE ON THE PROCESS. Hinds, J. A. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 16: 230-231(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15008 SITING POWER PLANTS IN WASHINGTON STATE. Greager, O. (Thermal Power Plant, Olympia, WA). Trans. Amer. Nucl. Soc.; 16: 231(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15009 STATE'S ROLE IN NUCLEAR POWER PLANT SITING. Kane, T. E. (Dept. of Justice, Raleigh, NC). Trans. Amer. Nucl. Soc., Suppl., 16: No. 1, 6-7(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15010 LEGAL IMPLICATIONS OF AEC LICENSING OF NUCLEAR POWER REACTORS TO BE OPERATED IN AN OCEAN ENVIRONMENT. Shapar, H. K. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 7 (1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15011 ENVIRONMENTAL STUDIES FOR AN OFFSHORE NUCLEAR POWER PLANT. Roney, J. R. (Public Service Electric and Gas Co., Newark, NJ). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 8-9(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15012 SITING CONSTRAINTS FOR AN OFFSHORE NUCLEAR POWER PLANT. Fischer, J. A.; Fox, F. L. (Dames and Moore, Cranford, NJ). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 9 (1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15013 REGIONAL CONSIDERATIONS FOR THE DESIGN OF AN OFFSHORE NUCLEAR POWER PLANT. Fischer, J. A.; Singh, H.; McWhorter, J. G. (Dames and Moore, Cranford, NJ). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 9-10(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15014 SITE INVESTIGATIONS FOR AN OFFSHORE NUCLEAR POWER PLANT. Dette, J. T.; Stahl, L.; Fischer, J. A. (Dames and Moore, Cranford, NJ). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 10-11(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15015 COMPARISON OF VARIOUS OFFSHORE NUCLEAR POWER PLANTS FOR CALIFORNIA. Ducey, F. D. (Holmes and Narver Inc., Anaheim, CA). Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 11-12(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15016 ENVIRONMENTAL AND OTHER IMPACTS FROM FLOATING NUCLEAR POWER PLANTS ALONG THE CALIFORNIA COAST. Catton, I. (Univ. of California, Los Angeles); Erdmann, R.; Garrett, P.; Godbout, P.; Kastenberg, W.; McVey, K.; Moscati, A.; Okrent, D.; Paige, S.; Smith, C.; Sokolow, B.; Wassel, A. T.; Citek, G.; Soule, D. Trans. Amer. Nucl. Soc., Suppl.; 16: No. 1, 12(1973).

From meeting on the ocean, nuclear energy and man; West Palm Beach, Florida, USA (25 Apr 1973). See CONF-730427-.

15017 LICENSING AS VIEWED FROM THE ENGINEER-CONSTRUCTOR'S POSITION. Kennedy, W. J. L. (Stone and Webster Engineering Corp., Boston). Trans. Amer. Nucl. Soc.; 16: 231-232(Jun 1973).

GENERAL

Energy Utilization and Economics

Refer also to abstracts 12618, 12883, and 12887.

15018 (CONF-730807-1) TRACE ELEMENT MASS BALANCE AROUND A COAL-FIRED STEAM PLANT. Bolton, N. E.; Carter, J. A.; Emery, J. F.; Feldman, C.; Fulkerson, W.; Hulett, L. D.; Lyon, W. S. (Oak Ridge National Lab., Tenn.). 1973. Contract W-7405-eng-26. 10p. Dep. NTIS $3.00.

A study was made at the Thomas A. Allen Steam Plant in Memphis, Tennessee, that has an 870 MW(e) peak capacity from three similar cyclone boilers to determine the fate of trace elements in coal associated with generation of electricity. Sampling and methods of analyses for mercury, lead, cadmium, arsenic, selenium, vanadium, zinc, nickel, chromium, antimony, and beryllium are described. (JCW)

15019 (CONF-730807-3) HYDROGEN AND SYNTHETIC FUELS FOR THE FUTURE. Michel, J. W. (Oak Ridge National Lab., Tenn.). 1973. 36p. Dep. NTIS $4.00.

Synthetic fuels can be produced at remote, well-regulated plants and would not contribute to the primary pollution problems that exist in urban centers. Production, storage, transportation, end uses, and overall systems analyses are evaluated for new fuel systems. Emphasis is on hydrogen and other fuels from nonfossil sources, but a section is included on the use of coal to produce hydrogen and methanol. Comparative characteristics of hydrogen, ammonia, hydrazine, methanol, methane, ethanol, and gasoline (C_8H_{18}) are tabulated. (JCW)

15020 (LA-5289-MS) GEOTHERMAL ENERGY. Smith, M. C. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 31p. Dep. NTIS $4.00.

Geothermal energy and its present and projected uses in terms of economics, current technology, and environmental impact are discussed. Both the advantages and disadvantages of geothermal energy and its conversion to electricity are presented briefly. (auth)

15021 (LA-UR-73-849) COMBINED NUCLEAR AND HYDROGEN ENERGY ECONOMY: A LONG-TERM SOLUTION TO THE WORLD'S ENERGY PROBLEM. Booth, L. A.; Balcomb, J. D.; Edeskuty, F. J. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 9p. (CONF-730811-8). Dep. NTIS $3.00.

Future demand for the world's supply of carbon-based fuels eventually will exhaust this supply until their use becomes economically infeasible. Hydrogen, which is virtually inexhaustible in the form of water, could be substituted for natural gas and petroleum-based fuels for industrial and residential heating and for transportation. Nuclear energy, either fusion or fission, would be the primary energy source. Thermal energy from the nuclear heat source would be converted to electrical energy in a conventional heat-engine cycle. Hydrogen could be produced from water by a cyclic thermochemical process. Gaseous hydrogen for industrial and residential heat would be transported in a high-pressure pipeline system. Liquid hydrogen stored in metal hydrides could be used for transportation fuels. The basis of this future energy economy would be energy complexes of two types. Large plants, located off shore would produce hydrogen and electricity with desalted water as a byproduct. Smaller plants, located inland near urban centers, would produce primarily electricity and hydrogen. (auth)

15022 (LA-UR-73-499) ANOTHER RIO GRANDE FOR NEW MEXICO. Reinig, L. P.; Brasier, R. I.; Donham, B. J.; Gregory, W. S. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 13p. (CONF-730438-1). Dep. NTIS $3.00.

An immense project is described that would produce the equivalent of another Rio Grande for the state of New Mexico to provide for large quantities of electric power and clean water. The project concept is based on desalting, ultimately by means of geothermal or nuclear energy, the several hundred million acre-feet of saline ground water in the Tularosa Valley. It would provide one million acre-feet of fresh water per year, 2000 megawatts of electric power, valuable magnesium and other minerals separated from the saline water at a rate of several million tons per year, and many associated recreational and social benefits. (JCW)

15023 (UCID-16265) PRELIMINARY COAL GASIFICATION EXPERIMENTS. Pasternak, A.; Taylor, R. W.; Bowen, D. (California Univ., Livermore. Lawrence Livermore Lab). 11 May 1973. Contract W-7405-eng-48. 24p. Dep. NTIS $3.25.

The reaction rates of a Wyoming subbituminous coal heated in steam and steam-hydrogen mixtures were investigated at temperatures up to 725°C. At about 500°C pyrolysis produces methane, carbon dioxide, and char. Pyrolysis may be a significant source of methane in an in situ process. The minimum temperature for rapid reaction of coal or char with steam or steam-hydrogen mixtures is about 625°C. The products are mostly hydrogen and carbon dioxide. Gasification rates decrease with time at a fixed temperature. Methane production increases when hydrogen is added to the steam. The activation energy for gasification in a large excess of steam was found to be 25 kcal/mole. (auth)

15024 SYNTHETIC FUEL ENERGY SYSTEMS BASED ON FUSION REACTORS: TECHNOLOGY, ECONOMICS, AND ENVIRONMENTAL EFFECTS. Powell, J. R.; Salzano, F. J.; Sevian, W. A.; Hoffman, K. C. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 16: 239-240(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15025 FEASIBILITY STUDY OF A COORDINATED SOLAR-NUCLEAR SYSTEM IN AN INTEGRATED POWER NETWORK. Malaviya, B. K. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Amer. Nucl. Soc.; 16: 240-241(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15026 ENERGY AND THE FUTURE. Hammond, A. L.; Metz, W. D.; Maugh, T. H. II. Washington, DC; American Association for the Advancement of Science (1973). 196p. $3.95.

With the depletion of fossil fuels, the new source of energy available is nuclear power. Use of nuclear power cannot expand quickly enough to fill the gap left by the unavailability of traditional fuels. The necessity of importing larger quantities of oil looms, and the effect on the economy is discussed. The energy crisis is discussed in six chapters: Energy from Fossil Fuels; Nuclear Energy; Alternative Energy Sources; Energy Transmission; Energy Conservation; and Energy Policy. (JCW)

15027 ENERGY AND ECOLOGY. McLean, J. G. (Continental Oil Co., Stamford, CT). Chem. Eng. Progr.; 69: No. 5, 29-36(May 1973).

Facts regarding the U. S. energy outlook are summarized and the accompanying economic and political implications of these facts are outlined. The energy-related domestic and foreign policies are discussed. A pragmatic approach to environmental problems created by the production and use of energy is suggested, namely: (1) striking a better balance between costs and social benefits in the pursuit of our environmental objectives, and (2) establishing more realistic time schedules for achievement of our environmental goals. (JCW)

15028 ADMINISTRATION'S PLANT SITING AND ENERGY POLICIES. DiBona, C. J. Pub. Util. Fortn.; 91: No. 13, 21-26 (21 Jun 1973).

The proposed Electric Facilities Siting Act of 1973 as recommended in President Nixon's message on the environment on Feb. 17, 1973 and introduced in the 93rd Congress is discussed. Legislative provisions deal with long-range planning, organization of certifying agencies (state and federal), certification procedures, and actual certification authority. Questions and answers on the President's Energy Message to Congress are presented. (JCW)

15029 OPEN PLANNING FOR CORPORATE RESPONSIBILITY. Seeley, W. S. Pub. Util. Fortn.; 91: No. 13, 41-42(21 (21 Jun 1973).

The Northern States Power Company has persuaded Minnesota's Environmental Quality Council that open planning power plant siting—involving public and governmental participation—can save substantial amounts of money in minimizing plant permit delays, legal fees, and management time spent in prolonged public confrontation. (auth)

15030 ENVIRONMENTAL IMPACT OF A FLOATING NUCLEAR PLANT. Nutant, J. A. Pub. Util. Fortn.; 91: No. 13, 36-40(21 Jun 1973).

A floating nuclear power plant will have minimal environmental impact upon marine biology, land- and water-use considerations, and aesthetic quality. While some impact is inevitable, it is expected to be well within the bounds of environmental restraints. Potential damage from chemical and thermal discharges are expected to be minimized by built-in safety precautions. (auth)

15031 INDIA FACES POWER FAMINE. Energy Int.; 10: No. 3, 18-20(Mar 1973).

Because of fair rapid industrialization and the establishment of power-hungry industries like aluminum, coupled with the vagaries of monsoon, heavy transmission losses and failures, and breakdowns in fossil-fueled and nuclear plants, power generation falls short of what is actually needed to maintain power stability. The reservoirs of hydro schemes that account for 40% of the country's power generation are only half full in the 1970s. Indian natural resources for power generation comprise coal, lignite, oil, natural gas, water, natural uranium and thorium, solar energy, and small quantities of geothermal energy. The geographical distribution of coal and water resources is not uniform and as such the three major sources—fossil fuels, hydro, and nuclear—have to be judiciously used in combination to achieve generation at minimum cost. The bulk of India's coal is of poor quality, and the coal fields are at great distances from thermal stations, making transport an uneconomical proposition. India has the largest thorium deposits in the world. Nuclear power development in the country is discussed. (JCW)

15032 TIDAL POWER. Proceedings of an International Conference on the Utilization of Tidal Power, Halifax, Nova Scotia, May 24–29, 1970. Gray, T. J.; Gashus, O. K. (eds.). New York; Plenum Publishing Corporation (1972). 636p. (CONF-700579-). $28.00.

The possibility of utilizing the oceans' pollution-free tidal power is receiving renewed interest. Contributors at this conference, experts in their fields, report on such topics as successfully operating pilot projects, design and operational aspects of large tidal power developments, and the economic and environmental effects of tidal power development. In essence, the many advantages and complexities involved in large tidal power projects are reviewed in this volume. (JCW)

15033 TOWARD A NATIONAL ENERGY POLICY. Friedlander, G. D. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 6, 36-43(Jun 1973).

As early as 1952, a Presidential commission realized the need for a government-inspired and -coordinated energy policy, but today, with our energy demands spiraling, our internal resources seriously depleted, and our economy weakened by an adverse balance-of-trade deficit that precludes indefinitely increasing fuel purchases from abroad, what energy policies exist are promulgated by 64 difference agencies. A tabulation of the federal agencies that presently administer energy policies and programs is shown. The task is monumental for coordination and augmentation of the federal operating programs and reorganization for energy implementation is proposed. (JCW)

Information Handling

Refer also to abstracts 15064, 15066, and 15159.

15034 (AEEW-M-1119) WORD-LENGTH LIMITATIONS ON THE PERFORMANCE OF LINEAR DIGITAL FILTERS. Knowles, J. B. (Atomic Energy Establishment, Winfrith (England)). Mar 1973. 48p. Dep. NTIS (U. S. Sales Only) $4.50.

This memorandum is intended as a survey of the available analysis of quantization and rounding errors as they affect the performance and design of linear digital filters. With the increasing use of mini-computers as on- and off-line data processors, this information may be useful to electronic engineers engaged in the development and specification of such systems. (4 tables, 19 figures, 26 references). (LMT)

15035 (CONF-730533-1) CURRENT TRENDS IN MAKING INFORMATION CENTERS SELF-SUPPORTING BY CHARGING FOR THE SERVICES. Kertesz, F.; Cape, J. D. (Oak Ridge National Lab., Tenn.; Technical Information Center (AEC), Oak Ridge, Tenn.). 1972. 16p. Dep. NTIS $3.00.

From first European congress on documentation systems and networks meeting; Luxembourg, (15 May 1973).

15036 (ORNL-TM-4295) DESCRIPTION AND EVALUATION OF THE INFORMATION AND DATA CENTERS AT THE OAK RIDGE NATIONAL LABORATORY. Nicholson, M. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

A general definition of information and data analysis centers is given. A brief survey of the information and data centers at Oak Ridge National Laboratory (ORNL) shows that they have a number of similarities that distinguish them as information centers. These similarities tend to overshadow the important differences found to exist among the centers. These differences are caused by a number of factors, including the different scientific communities that are served, the effects of budget cuts, and the basic differences in philosophies of the directors of the centers. In describing the information and data centers at ORNL, it is also important to distinguish between information centers and information analysis centers, as not all of the ORNL centers can accurately be called information analysis centers. (auth)

15037 NUCLEAR DOCUMENTATION. Perette, J. L. Bull. Inform. A. T. E. N. (Ass. Tech. Energ. Nucl.); No. 97, 19-46 (1972). (In French).

From third international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The present state and the characteristics of nuclear documentation are discussed together with the nature, form and availability of documents and the linguistic aspects of the subject. Three types of document are defined. The primary sources of document consist of original work published in reviews, books, reports, theses, and patents together with the computer programs. The secondary sources consist of information on how matter can be obtained from primary sources and the contents of such sources: general bibliographic bulletins specialized in particular subjects or types of information, bibliographies, tables of neutron constants and references for retrieval and historical research. The principle of the selective dissemination of information with and without the utilization of the thesaurus is exposed. The INIS program of IAEA is described. General information consists of economic, industrial, financial and statistical information not ordinarily indexed in the secondary sources. A list of 75 reviews classed under 5 principal subjects and covering the sciences and nuclear techniques is presented. (FR)

Management

15038 (CONF-730518-2) RADIOLOGICAL ASSISTANCE TEAM: ORGANIZATION AND EXPERIENCE. Lonergan, G. T. (Argonne National Lab., Ill.). May 1973. 51p. Dep. NTIS $4.75.

From AIHA conference; Boston, Massachusetts, USA (20 May 1973).

The organization and development of a Radiological Assistance Team within the framework of the Interagency Radiological Assistance Plan is reviewed. The responsibilities of certain key positions within the Chicago Operations Office and Argonne National Laboratory and their role in implementation of the Region 5 Radiological Assistance Plan are summarized. The operational duties and responsibilities of those required to respond to requests for radiological assistance are outlined. Team equipment, instrumentation, communication, and training are described. A summary of radiological assistance responses by the Atomic Energy Commission Chicago Operations Office and the Argonne National Laboratory Team is provided. Appendices listing instruments, accessories, equipment, special kits, and protective clothing are included. (auth)

15039 (LA-5248) PLAN2: A RECEIPTS AND DISBURSEMENTS CODE FOR PREPARING R AND D OPERATING PLANS. Harris, D. R. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 12p. Dep. NTIS $3.00.

PLAN2, a FORTRAN-IV code for the CDC and UNIVAC computers, prepares receipts and disbursements operating plans for management planning of research and development organizations. A particular, but representative, relationship of management, costing, and funding structures is assumed. (auth)

15040 (STI/DOC-10/144) IAEA RESEARCH CONTRACTS. Thirteenth Annual Report. (International Atomic Energy Agency, Vienna (Austria)). May 1973. 237p. IAEA $10.00.

The annual report contains 87 summaries from the scientists in the participating countries belonging to the IAEA. The areas of nuclear science and technology on which research was performed include nuclear power and reactors, waste management, physics and chemistry, radioisotopes and radiation, agriculture, food, industry, medicine, dosimetry, hydrology, man and his environment, radiation biology, radiological safety, the environment, and safeguards. (JCW)

15041 (UCRL-51378) CPM: A PROGRAM FOR CRITICAL PATH MANAGEMENT. McCall, J. R. (California Univ., Livermore. Lawrence Livermore Lab.). 9 Apr 1973. Contract W-7405-Eng-48. 53p. Dep. NTIS $5.45.

A computer program to assist in the application of the Critical Path technique of project management (CPM) is presented. The purpose and philosophy of the technique are described. Preparation of the input deck is detailed. The available output options are described. A simple example is followed from project conception

to examination of the computer generated output. The Appendix details the algorithm used for generation of the CPM project chart. (auth)

Mathematics and Computers

Refer also to abstracts 14267, 14268, and 15039.

15042 (AAEC/E-243) PDP11ASM AND PDP11 SIM: A PDP11 ASSEMBLER AND A PDP11 SIMULATOR TO RUN ON AN IBM360 COMPUTER. Cox, G. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1972. 64p. Dep. NTIS (U. S. Sales Only) $5.25.

An assembler and a simulator for the PDP11 computer, written to run on an IBM360 computer are described. They provide a convenient and efficient way to prepare and test programs for the PDP11. Programs may be tested which use all of the PDP11 facilities, including input–output instructions and internal and external traps. (auth)

15043 (AAEC/E-256) AEJCL: A JCL SYNTAX CHECKING FACILITY. Hayes, I. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

AEJCL provides a listing and JCL syntax checking facility on a PDP/9L computer system. The syntax checking system is controlled by a directed graph structure which is initially written in a machine-independent language and then translated to PDP/9L code automatically. The input and output sections of the system are handled asynchronously by a multitasking master control program. (auth)

15044 (ANL-7988) AMP, A DYNAMIC MICROPROCESSOR. Barr, R.; Becker, J.; Lidinsky, W.; Tantillo, V. (Argonne National Lab., Ill.). Jun 1973. Contract W-31-109-eng-38. 67p. Dep. NTIS $5.45.

A horizontally structured microprogrammable processor (AMP) designed as a tool for microcontrol, language, and processor design research, is described. The machine employs a minimally encoded microcontrol word, a general multiple-bus structure, high-speed local storage, several arithmetic/logic units, and completely asynchronous memory referencing. These features combine to yield substantial low-level parallelism and a very versatile microinstruction. In addition, hardware modification is easily accomplished, further supporting the experimental nature of the processor. (auth)

15045 (CEA-R-4397) RESEARCH INTO THE OPTIMAL UTILIZATION OF MAGNETIC MATERIALS IN PLATED-WIRE MEMORIES. Serindat, H. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1973. 110p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis. Submitted to Grenoble Univ., France.

Plated wire memories are particularly sensitive to two kinds of perturbations because of the absence of material separation between neighboring memory points along a plated wire. During the read process, it is difficult to localize the magnetization rotation. Therefore, the field and the magnetization distribution were studied. and the gathered flux was computed. New high-density structures were computed from computer program results. During the write process, the written domain spreads during multiple writings. This may lead to the destruction of the information previously recorded in the neighboring cells. Two processes were proposed to avoid this drawback. (25 references) (auth)

15046 (CONF-730812-1) COMPUTER CONSTRUCTION OF SMALL "D-OPTIMAL" INCOMPLETE BLOCK DESIGNS. Mitchell, T. J. (Oak Ridge National Lab., Tenn.). 1972. 7p. Dep. NTIS $3.00.

Results are presented of an application of DETMAX to a common design problem, namely the grouping of r replications of each of v treatments into 6 blocks of size k. The incomplete block problem where $k < v$ is discussed. (MOW)

15047 (COO-1469-223) RATION: A RATIONAL ARITHMETIC PACKAGE. Brown, R. L. (Illinois Univ., Urbana. Dept. of Computer Science). Jun 1973. Contract AT(11-1)-1469. 40p. (UIUCDCS-R-73-572). Dep. NTIS $4.00.

The theoretical basis for representing a rational number using the prime factorization of its minimal integer ratio is given, and the resulting algorithms for performing addition, subtraction, multiplication, and division are developed. The conjecture that these algorithms will normally require fewer machine operations than algorithms based on storing rational numbers as two long integers is supported by a worst-case machine-operation-count estimate for each. These operation counts are applied to parameters derived from test results. A self-contained user's manual for RATION is given next. (auth)

15048 (JUL-908-MA) STRIP: A MODIFIED TRAC IMPLEMENTATION FOR THE PDP-8/1. Ketzer, H. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik). Dec 1972. 65p. Dep. NTIS (U. S. Sales Only) $5.25.

STRIP is a small modified TRAC version implemented for use on a PDP/8 computer with 8K of core memory only and a teletype. The implementation and some STRIP applications are discussed. (MOW)

15049 (K-GD-808) FAST FOURIER TRANSFORM FOR THE MODCOMP COMPUTER. Dunthorn, D. I. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 5 Jun 1973. Contract W-7405-eng-26. 15p. Dep. NTIS $3.00.

The methods used in programming a Fast Fourier Transform (FFT) for a time series of 2048 data points on a Modcomp III computer are described. In the real-time mode, the program operates on one block of 2048 points, while another block is being read by a direct memory access multiplexer operating at 2048 Hz. The results of the tranform, in terms of signal amplitude versus frequency, are plotted on a storage CRT display. The program uses 16-bit integer arithmetic and performs the transform in 0.50 second of computation, including the calculation of amplitude from the complex Fourier coefficients, so that the computer is still about 50% available while performing transforms continuously. Storage requirements are about 6K words, including the two 2K data blocks. (auth)

15050 (KFK-PDV-1) PEARL: A PROPOSAL FOR A PROCESS AND EXPERIMENT AUTOMATION REALTIME LANGUAGE. Timmesfeld, K. H.; Schuerlein, B.; Rieder, P. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany)). Apr 1973. 203p. (In German). Dep. NTIS (U. S. Sales Only) $12.25.

A middle-level programming language is described that allows to formulate the structure, the algorithms, time behavior and I/O of realtime programs. It was developed by a group of German industrial firms and research institutes and is intended for the process control engineer or experimenter with some programming experience. The report describes mainly the semantics of the language, but contains also application examples and an alphabetic list of the syntax formulas. (auth)

15051 (LA-UR-73-565) COMPUTER PROGRAM OPTIMIZATION USING SOFTWARE MONITORING TECHNIQUES. McGirt, A. F.; Rudsinski, L. E.; Melendez, K. J. (Los Alamos Scientific Lab., N. Mex.). 1972. Contract W-7405-eng-36. 8p. (CONF-730501-1). Dep. NTIS $3.00.

From AEC scientific computer information exchange meeting; San Francisco, California, USA (3 May 1973).

Concern about the efficient use of computer resources at the Los Alamos Scientific Laboratory (LASL) has led to the development of software performance measurement tools and a formal computer program optimization project. In this paper the design, implementation, and use of such tools are discussed. A description of the optimization project execution procedures and typical gains in program efficiency versus manpower and machine time costs is given. Problems and recommendations which are of interest to others who plan development of computer performance measurement tools or establishment of formal optimization projects are discussed. (auth)

15052 (LA-UR-73-890) ALGORITHMIC LANGUAGES AND MACHINE ORIENTED TASKS. Wells, M. B. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 23p. Dep. NTIS $3.25.

This paper presents the point of view that very-high-level languages can and should be applied for the specification and programming of machine-oriented tasks. The essential concept is that the language and a compiler for the language must not be confused. Features that such a language should have are discussed. (auth)

15053 (ORNL-TM-4258) PROGRAM TO EVALUATE THE SECOND FORM OF THE CONFLUENT HYPERGEOMETRIC FUNCTION. Larson, N. M.; Lucas, I. J. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

Subroutine KUMMER and various auxiliary subroutines were developed to evaluate U(a, b, z), the second form of the confluent hypergeometric function, for real values of a, b, and nonnegative z. (auth)

15054 (RISO-M-1591) DEVELOPMENTS IN PROCESS CONTROL COMPUTER SYSTEMS (1973–1978). Taylor, J. R.; Goodstein, L. P. (Danish Atomic Energy Commission, Risoe. Re-

search Establishment). Mar 1973. 73p. Dep. NTIS (U. S. Sales Only) $5.75.

A brief review of the situation regarding the use of process computers as it stands today is presented. It can serve as a reference framework against which some ideas about future developments to be given later can be viewed, compared and evaluated. The applications which are of direct interest here lie in the areas of conventional and nuclear power generation. The review is restricted to the situation in the UK and Canada since the utilization of computers in power plants has to some extent been the most advanced in these two countries. However, reference should also be made to work being carried out in Germany and Norway. (MOW)

15055 (RISO-M-1594) RISOE HYBRID COMPUTER EAI 680-PDP8/I,FPP12. Soee Hoejberg, K. (Danish Atomic Energy Commission, Risoe. Research Establishment). May 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

A description is given of a hybrid computer including analog computer EAI 680, digital computer PDP8/I, and floating-point processor FPP12. The interface system is Risø/DEC. In addition a RK8, 812 k disk and a TC08/TU56 DECTAPE station are included. A short description is also given of the software system, which is based upon the OS/8 monitor. The system contains a RTPS FORTRAN IV compiler, SABRE, RALF assemblers and various hybrid software including interface-handling functions and a hybrid computer language. (auth)

15056 (RT/EL-(73)1) PDP-11 BASIC EXTENSION FOR CAMAC PROGRAMMING. Bals, I.; De Agostino, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Jan 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

A composite language based on BASIC and assembly subroutines designed to work with the CAMAC in connection with a PDP-11 computer is described. (auth)

15057 (SLA-73-479) COMPARISON OF ERRORS IN LINEAR DIGITAL MODELS. Stearns, S. D. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 9p. (CONF-730624-1). Dep. NTIS $3.00.

From Joint Automatic Control Conference; Columbus, Ohio, USA (20 Jun 1973).

Given the description of a continuous linear system in terms of its transfer function, there are several common schemes for constructing a digital model of the system that is accurate for arbitrary input signals. Some of the simple schemes are discussed here and evaluated in terms of certain error measures. Digital transfer functions are also tabulated for first- and second-order systems. Three classes of operating conditions for the linear digital model are defined in terms of the sampling interval or time step. The first is the trivial class where the time step is so short that the error measures are negligible for even the simplest (impulse-invariant) model. In the other two classes the errors are discussed and compared, and error bounds are established for first- and second-order transfer functions. The conclusion is that the ramp-invariant model, so-called because its performance is invariant when the input is composed of connected ramp segments, is one of the best of the simple models and a good standard to use for evaluating more complicated models requiring computer optimization. (auth)

15058 (SLA-73-5501) SANDIA APPROACH TO ELECTRON-PROBE AUTOMATION. Chambers, W. F. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 3p. (CONF-730809-1). Dep. NTIS $3.00.

From 8th national conference on electron probe analysis; New Orleans, Louisiana, USA (13 Aug 1973).

The development process of electron-probe automation is reviewed. The newest system was designed around a PDP-8 series computer. It includes a 12k PDP-8/E with dual DECtape at DECwriter, an analog-to-digital converter, a CTR display, and ARL interfaces to the stepping motor, scalar-timer, digital-to-analog converter, and multiplexer systems. This system is discussed. (MOW)

15059 (SLA-73-5454) SANDIA INTERACTIVE GRAPHICS SYSTEM: SIGS. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 25p. (CONF-730526-1). Dep. NTIS $3.25.

A generalized interactive computer graphics system has been released for production use at Sandia Laboratories. The system utilizes four remote PDP-9 computers and Vector General 3D2 displays interfaced to a central CDC-6600 computer. The hardware configuration and basic system operating software are first described. The organization of the display file and its generation via FORTRAN callable display generation routines (DGR's) at the 6600 are then discussed. The manipulation of the display file and control of the graphics job via PDP-9 FORTRAN callable display manipulation routines (DMR's) and utility routines are described. A typical job run from the PDP-9 to the CDC-6600 is then presented. Current and future application programs using SIGS are then listed. (auth)

15060 (SLAC-161) COMPUTING WITH MULTIPLE MICRO-PROCESSORS. Levy, J. V. (Stanford Linear Accelerator Center, Calif.). Apr 1973. Contract AT(04-3)-515. 168p. Dep. NTIS $7.60.

Thesis.

Computer systems with multiple processors are becoming more common for reasons of reliability and modularity. The use of asynchronous processors, however, leads to problems of complexity of control and of programming. This work investigates the application of multiple asynchronous processors to the computing task at the lowest level—that of interpreting single machine-language instructions. (MOW)

15061 (STI/PUB-306) COMPUTING AS A LANGUAGE OF PHYSICS. Lectures Presented at Trieste, 2–20 August 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 624p. (CONF-710849-). IAEA $21.00.

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971).

Separate abstracts were prepared for 17 papers from this seminar. (LTW)

For abstracts of individual papers see: 12955, 12956, 13117, 13483, 13484, 13589, 13590, 13722, 14161, 14162, 14171, 14266–14268, and 15068–15070.

15062 (UCID-16212) XPL USER'S MANUAL. Wetherell, C. (California Univ., Livermore. Lawrence Livermore Lab.). 20 Feb 1973. Contract W-7405-eng-48. 111p. Dep. NTIS $7.75.

This paper describes the XPL language as implemented for the Gordo time-sharing system running on the XDS Sigma-7 at Lawrence Livermore Laboratory. XPL is a language designed for the implementation of compilers and for other semi-symbolic programs by McKeeman, Horning, and Wortman as described in their book A Compiler Generator (Prentice-Hall, 1970). XPL (Gordo) is a particular implementation of the XPL language with most deviances from the published standard induced by the differences between the IBM System/360 and the XDS Sigma-7. Included in this description of XPL(Gordo) are details of the language as seen by the user, instructions for its use within the Gordo system, and details of the implementation. (auth)

15063 (UCID-30059) GEARB: SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS HAVING BANDED JACOBIAN. Hindmarsh, A. C. (California Univ., Livermore. Lawrence Livermore Lab.) May 1973. Contract W-7405-eng-48. 32p. Dep. NTIS $3.75.

GEARB is a package of subroutines for the numerical solution of systems of ordinary differential equations in which the Jacobian matrix has a band structure. It is a slightly modified version of the package described in GEAR: Ordinary Differential Equation System Solver, UCID-30001 (Rev. 1). This report describes those modifications and the corresponding changes in the usage of the package. (auth)

15064 (UCLA-10-P-14-121) ANNUAL PROGRESS REPORT. (California Univ., Los Angeles. Dept. of Computer Science). May 1973. Contract AT(11-1)-Gen-10. 21p. Dep. NTIS $3.25.

During the 1972–73 contract year, significant progress was made in investigations of extensible architecture, models of computations, development of an improved methodology for synthesis of information processing systems, and in extensible processor studies. (auth)

15065 (UCRL-74818) SOME COMPUTATIONAL ASPECTS OF THIN WIRE MODELING. Miller, E. K.; Deadrick, F. J. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Jun 1973. 107p. Dep. NTIS $7.50.

Some of the computational aspects that may affect the validity and applicability of a numerical solution for a thin-wire structure are considered. These include: (1) structure segmentation, (2) current expansions, (3) the thin-wire approximation, (4) matrix factorization roundoff error, (5) near-field numerical anomalies, (6) multiple junction treatment, (7) wire-grid modeling, and (8) computer time required. The discussion is based upon results obtained from a subsectional-collocation and point-matching solution to the thin-wire integral equation, but the implications that arise are of a more general nature. Minimizing the possibly deleterious impact of the above on performing practical calculations is discussed. (auth)

15066 (UCRL-74761) FUTURE TRENDS IN COMPUTER HARDWARE. Feustel, E. A.; Jensen, C. A.; McMahon, F. H. (California Univ., Livermore. Lawrence Livermore Lab.). 22 May 1973. 9p. (CONF-730706-1). Dep. NTIS $3.00.

From computational fluid dynamics conference; Palm Springs, CA (19 Jul 1973).

Vector processors, parallel processors, and sequential processors with much concurrency are considered. Some real codes can be shown to be almost completely suitable for parallel and vector processors. However, vector to scalar speed ratios can be so large for the vector and parallel machines that even a small residual scalar content is a serious problem. Monte Carlo approaches and implicit differencing schemes yield shorter vectors than explicit differencing schemes, causing problems due to long-vector-operation startup times. Programming in a vector language may be a more global and easier to understand approach to programming. It is necessary to use such an approach in order to attain some reasonable fraction of the potential speed of a vector or parallel processor. (auth)

15067 (Y-1882) MAGNETIC CORE MEMORY FOR A NUMERICAL CONTROL SYSTEM. Williams, T. L. (Oak Ridge Y-12 Plant, Tenn. (USA)). 11 Jul 1973. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

A magnetic core memory system was developed for use on a continuous-path numerical-control system. The memory is used as a part-description data source instead of punched tape. This modification was made in an effort to determine if problems associated with the controller are directly related to the tape reader. The memory is interfaced to the controller in a manner such that part description data can flow from numerical control to memory for storing data or from memory to numerical control for normal machine control. Memory systems were installed on a two-axis and a four-axis controller. These machines are in regular production and are functioning satisfactorily. (auth)

15068 COMPARATIVE SURVEY OF PROGRAMMING LANGUAGES. Campbell, J. A. (Univ. of Texas, Austin). pp 391-484 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

The range of programming language available to the physicist is reviewed. Knowledge of FORTRAN is assumed. Three major classes of languages are distinguished: languages for numerical processing, languages for symbolic processing, and string-processing languages. In that order, the chief representatives of the three classes for the purpose of discussion are FORTRAN, LISP and SNOBOL. Other languages of each type are outlined to show how it is possible to make approaches to certain computing operations which are different from the approaches used by the chief languages of each class, and sometimes better. PL/I is mentioned as a language which is intended to combine attributes of all three classes. Two further classes of less general interest are acknowledged; languages for simulations (e.g. SIMULA 67) and systems for the management of large data-bases (e.g. RFMS). Operations or structural properties which are common to all or most of the languages are set out individually and their treatment by different languages is examined on a comparative basis. Several programming problems are given, together with their solutions in different languages, side by side. Including FORTRAN, 13 languages are discussed. (auth)

15069 DELPHI-SPEAKEASY SYSTEM. Cohen, S. (Argonne National Lab., IL). pp 521-528 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

This paper describes a system of modular computer programs designed to provide investigators in the physical sciences with more convenient access to the power of a modern computer. Constructed within the framework of a special storage technique, the routines of the system resemble true mathematical operators. A new problem is programmed by bringing together the needed operators with a simple directive program. To make the construction of this control program even more direct, a new interpretative computer language called SPEAKEASY has been designed. The power of this language to provide quick results has already proved its worth. The growth of this language is greatly enhanced by a recently added facility, used at execution time, by which it can be dynamically linked to user-contributed routines from logically separate libraries. (auth)

15070 INTRODUCTION TO LISP. Lurie, D. (CERN, Geneva). pp 529-554 of Computing as a Language of Physics. Vienna; International Atomic Energy Agency (1972).

From computing as a language of physics seminar; Trieste, Italy (2 Aug 1971). See STI/PUB-306; CONF-710849-.

The concept of a list and machine representation of lists are reviewed. S-expressions and basic LISP functions are discussed. LISP programming, LISP program structure, and a short LISP program for symbolic differentiation are discussed. (auth)

Miscellaneous

15071 (ANL-7970) DIVISION OF BIOLOGICAL AND MEDICAL RESEARCH ANNUAL REPORT, 1972. (Argonne National Lab., Ill.). Dec 1972. Contract W-31-109-Eng-38. 246p. Dep. NTIS $14.50.

For abstracts and/or titles of individual papers see: 12911, 13001, 13006–13011, 13017–13020, 13055–13071, 13094, 13095, 13104, 13105, 14227, and 15072–15124.

15072 (ANL-7970, pp 39-40) IDENTIFICATION OF THE CHROMOSOMES IN A MURINE LEUKEMIA STEM LINE BY AUTOMATED BANDING ANALYSIS. Carrano, A. V.; Hodges, D. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15073 (ANL-7970, pp 49-50) INCREASED TOTAL ACTIVITY AND ISOZYME COMPLEXITY OF ALDEHYDE DEHYDROGENASE IN CERTAIN RAT HEPATOMAS. Feinstein, R. N.; Cameron, E. C. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15074 (ANL-7970, pp 50-51) DETECTION OF OXIDASES ON POLYACRYLAMIDE GELS. Feinstein, R. N.; Lindahl, R. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15075 (ANL-7970, pp 51-54) EFFECTS OF AGE ON 2-ACETYLAMINOFLUORENE-INDUCED HEPATIC TUMORIGENESIS, HEPATOCYTE PROLIFERATION AND CARCINOGEN BINDING IN THE LIVER. Peraino, C.; Fry, R. J. M.; Kisieleski, W. E. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15076 (ANL-7970, pp 54-55) ENHANCEMENT BY PHENOBARBITAL OF 2-ACETYLAMINOFLUORENE-INDUCED HEPATIC TUMORIGENESIS IN THE RAT: CONSEQUENCES OF VARIOUS TEMPORAL COMBINATIONS OF 2-ACETYLAMINOFLUORENE AND PHENOBARBITAL TREATMENTS. Peraino, C.; Fry, R. J. M.; Staffeldt, E.; Kisieleski, W. E. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15077 (ANL-7970, pp 55) INTERACTIONS AMONG REGULATORS OF RAT LIVER ORNITHINE AMINOTRANSFERASE. Peraino, C. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15078 (ANL-7970, pp 56-57) SEPARATION OF PEPTIDES FROM CHYMOTRYPTIC DIGEST OF ORNITHINE AMINOTRANSFERASE. Peraino, C.; Morris, J. E. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15079 (ANL-7970, pp 57-59) AUTOMATION OF CONTINUOUS SUSPENSION CULTURES BY MEANS OF A NEPHELOSTAT. Peraino, C.; Eisler, W. J. Jr. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15080 (ANL-7970, pp 59-61) SPECIES SUSCEPTIBILITY TO ONCOGENIC AGENTS: URETHAN DISTRIBUTION AND CLEARANCE IN 3- TO 4-WEEK-OLD AND ADULT C3Hf AND C57BL/6 MICE. Kisieleski, W. E.; Fry, R. J. M. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15081 (ANL-7970, pp 63-65) STUDIES ON THE EFFECTS OF PSORALEN AND NEAR-ULTRAVIOLET LIGHT. Grube, D.; Fry, R. J. M. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15082 (ANL-7970, pp 66-68) USE OF THE SCANNING ELECTRON MICROSCOPE FOR THE STUDY OF THE LUMINESCENCE OF BIOLOGICAL MATERIALS. Oldfield, D. G.; Chubb, G. T. Dec 1972.

In Division of Biological and Medical Research annual report, 1972.

15083 (ANL-7970, pp 73-74) COMPARATIVE BIOLOGY OF AGING IN MYOMORPH RODENTS. I. Life Tables, Aging Processes, and Pathology. Sacher, G. A.; Flynn, R. J.; Duffy, P. H.; Tyler, S. A. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15084 (ANL-7970, pp 74-75) COMPARATIVE BIOLOGY OF AGING IN MYOMORPH RODENTS. II. Comparative Studies of the Nervous System. Sacher, G. A.; Flynn, R. J.; Svihla, G.; Sanderson, M. H.; Duffy, P. H. Dec 1972.
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15085 (ANL-7970, pp 77-78) GENETICS OF LONGEVITY IN LABORATORY MICE. Sacher, G. A.; Flynn, R. J.; Tyler, S. A.; Duffy, P. H. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15086 (ANL-7970, pp 78-79) AGING OF INSECTS IN RELATION TO ENERGETIC EFFICIENCY. Sacher, G. A.; Ross, R. H. Jr. Dec 1972.
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15087 (ANL-7970, pp 79-80) IMMUNITY AND AGING. I. KINETICS OF ANTIBODY PRODUCTION IN THE DOG. Jaroslow, B. N.; Suhrbier, K. M. Dec. 1972.
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15088 (ANL-7970, pp 81) IMMUNITY AND AGING. II. CLEARANCE OF FOREIGN RED CELLS IN AGING MICE. Jaroslow, B. N.; Larrick, J. W. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15089 (ANL-7970, pp 81) IMMUNITY AND AGING. III. Skin Graft Survival in Aging $B6CF_1$/ANL Mice. Jaroslow, B. N.; Koesterer, R. Dec 1972.
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15090 (ANL-7970, pp 82-83) MECHANISM OF ERYTHROCYTE AGING AND DESTRUCTION. I. Membrane Model for Erythrocyte Aging. Rahman, Y. E.; Wright, B. J.; Cerny, E. A.; Groer, M. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

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15092 (ANL-7970, pp 86-88) AGE DEPENDENCE OF PROTEIN SYNTHESIS. II. Age Dependence of Synthesis in Isolated Neutrons. Rahman, Y. E.; Moy, C. K. Dec. 1972.
In Division of Biological and Medical Research annual report, 1972.

15093 (ANL-7970, pp 88-89) LIPOSOMES AND MEMBRANE TRANSPORT. I. Distribution and Transport of Labeled Liposomes in Mouse Tissues. Rahman, Y. E.; Cerny, E. A.; Rosenthal, M. W.; Wright, B. J. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

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15095 (ANL-7970, pp 97-98) HORMONAL EFFECTS ON ^{3}H-THYMIDINE INCORPORATION INTO DNA OF PEAS. Sherwin, J. E.; Gordon, S. A. Dec 1972.
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15096 (ANL-7970, pp 99-100) NUCLEAR PHOSPHORYLATION IN PEA SEEDLING NUCLEI. Sherwin, J. E.; Gordon, S. A. Dec 1972.
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15097 (ANL-7970, pp 100-101) ALTERATIONS OF MITOCHONDRIAL OXIDATIVE PHOSPHORYLATION BY LIGHT. Sherwin, J. E.; Becker, A.; Gordon, S. A. Dec 1972.
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15098 (ANL-7970, pp 102-103) EFFECT OF RED AND BLUE LIGHT ON DNA SYNTHESIS IN PEA SEEDLINGS. Sherwin, J. E.; Gordon, S. A. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15099 (ANL-7970, pp 103-105) EFFECT OF MONOCHROMATIC BLUE AND RED LIGHTS ON THE GEOTROPIC RESPONSE OF THE PRIMARY ROOTS OF CORN. Shen-Miller, J.; Miller, R. M. Dec 1972.
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15109 (ANL-7970, pp 138-140) CIRCADIAN CYBERNETICS. I. Properties of the Ultradian Growth Mode in Free Living Eukaryotic Cells. A. Identification and Characterization of the Transition Mode. Antipa, G. A.; Ehret, C. F.; Meinert, J. C.; Sutherland, A. Dec 1972.
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15110 (ANL-7970, pp 140-141) CIRCADIAN CYBERNETICS. I. Properties of the Ultradian Growth Mode in Free Living Eukaryotic Cells. B. Synchronization by Transition Mode Autophasing in Tetrahymena Pyriformis. Antipa, G. A.; Ehret, C. F.; Meinert, J. C. Dec 1972.
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15116 (ANL-7970, pp 156-157) ENZYMATIC SYNTHESIS OF SELECTIVELY LABELED DINUCLEOSIDE MONOPHOSPHATES. Kondo, N. S.; Leung, A.; Danyluk, S. S. Dec 1972.
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15117 (ANL-7970, pp 161-163) IDENTIFICATION OF KETO BILE ACIDS IN HUMAN BILE. Szczepanik, P. A.; Watkins, J. B.; Hachey, D. L.; Klein, P. D. Dec 1972.
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15121 (ANL-7970, pp 209-211) SUPPLY AND MAINTENANCE OF DEFINED ANIMALS. I. Status of the Colony. Poole, C. M.; Fritz, T. E.; Brennan, P. C.; Flynn, R. J. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15122 (ANL-7970, pp 211) SUPPLY AND MAINTENANCE OF DEFINED ANIMALS. II. The Development of Inbred Catalase Mutant Mice. Poole, C. M.; Flynn, R. J.; Feinstein, R. N. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15123 (ANL-7970, pp 211-213) LABORATORY ANIMAL DISEASES. I. Studies of Murine Pneumonia. Brennan, P. C.; Kickels, W. T.; Simkins, R. C.; Fritz, T. E.; Flynn, R. J. Dec 1972.
In Division of Biological and Medical Research annual report, 1972.

15124 (ANL-7970, pp 214-215) LABORATORY ANIMAL DISEASE. II. Studies of Enterobacter Cloacae. Brennan, P. C.; Poole, C. M.; Simkins, R. C.; Kickels, W. T.; Flynn, R. J. Dec 1972.
In division of biological and medical research annual report,. 1972.

15125 (BARC-626) TRANSISTOR CURVE TRACER TYPE OS779 FUNCTIONAL DESCRIPTION AND APPLICATIONS. Ahuja, M. R.; Menon, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 39p. Dep. NTIS (U. S. Sales Only) $4.00.
Transistor curve tracer type OS779 has been developed by the Test Equipment & Display Systems Section of the Electronics Division of B.A.R.C. The salient features of the curve tracer along with the operational details are described. The display of the dynamic characteristics of transistors, diodes, zener diodes, FET'S, voltage regulator tubes, etc. can be obtained under the operating conditions. The various curves vividly illustrate the tests that can be carried out and the parameters that can be measured of the various semiconductor devices. (auth)

15126 (BNL-17883) MEDICAL AUTORADIOGRAPHY WITH STABLE ISOTOPE THYMIDINE: THEORY AND PRELIMINARY EXPERIMENTS. Slatkin, D. N.; Jones, K. W.; Geisler, F. H.; Wolf, A. P.; Fowler, J. S.; Kraner, H. W.; Cronkite, E. P. (Brookhaven National Lab., Upton, N. Y.). 1973. 21p. (CONF-730525-3). Dep. NTIS $3.25.
From conference on stable isotopes in chemistry, biology and medicine; Argonne, Illinois, USA (9 May 1973).

15127 (BNWL-SA-4704) COMPARISON OF THE LETHALITY OF VARIOUS COMBINATIONS OF HEAVY METALS AND WATER TEMPERATURE TO JUVENILE RAINBOW TROUT. (Battelle Pacific Northwest Labs., Richland, Wash.). [nd]. 5p. (CONF-730505-6). Dep. NTIS $3.00.
From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

15128 (CEA-R-4401) STUDY OF DISLOCATION CLIMB CREEP OF MAGNESIUM SINGLE CRYSTALS COMPRESSED ALONG THE ANTI c AXIS. Edelin, G. (Commissariat l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1973. 113p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.
Thesis. Submitted to Nancy Univ. (France).
Creep tests were performed on magnesium single crystals compressed along the $\bar{c}$ axis. Under these conditions, the crystals cannot deform by slip and creep was shown to proceed by pure climb of $\bar{c}$ dislocations lying in the basal planes. The climb rate of these dislocations was measured and depended on temperature with an activation energy of 1.80 ± 0.03 eV, greater than the activation energy for self-diffusion. The climb rate was found to depend on stress following a power law with a stress exponent $m = 2.7 \pm 0.1$. There is a significant disagreement between the experimental and theoretical values of the climb rate. This disagreement cannot be explained at the present time, but probably results from an oversimplification of the existing models. (auth)

15129 (CONF-730629-3) ELEMENTS OF DYNAMIC-INELASTIC DESIGN CODE. Blume, J. A. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). 1972. 10p. Dep. NTIS $3.00.
From fifth world conference on earthquake engineering; Rome, Italy (25 Jun 1973).
The need for a dynamic-inelastic design code that provides greater utilization of available knowledge than the current earthquake codes is discussed followed by the philosophy of such a code including the requirement for reasonable simplicity and workability. Elements of the code are presented as a supplementary section to existing static-elastic requirements. Two levels of earthquake intensity are specified. The dynamic-inelastic provisions are based upon kinetic energy reconciliation with energy stored, converted to heat, and used to do work in the inelastic range as in the reserve energy technique. (auth)

15130 (CONF-730704-2) COMPARISON OF MODELS OF AN OLD FIELD ARTHROPOD FOOD CHAIN. Mankin, J. B.; Shugart, H. H.; Van Hook, R. I. (Oak Ridge National Lab., Tenn.). 1971. 15p. Dep. NTIS $3.00.
From summer simulation conference; Montreal, Canada (17 Jul 1973).

15131 (CONF-730805-4) CRYOGENIC SYSTEM FOR A TOROIDAL THERMONUCLEAR FUSION EXPERIMENT. Long, H. M.; Luton, J. N. Jr. (Oak Ridge National Lab., Tenn.). 1972. 10p. Dep. NTIS $3.00.
During the last five years considerable progress has been made toward the goal of controlled thermonuclear fusion using toroidal magnetic fields. The largest toroidal experiment now underway, the ORMAK device at the Oak Ridge National Laboratory, employs liquid-nitrogen-cooled copper coils to produce fields up to 25 kG, using generators that supply 18 MW during

a 1.5-sec run every 10 min, depositing 9.4 MJ of energy. In addition, the cooling system must account for external heat leak and two other magnetic coil systems. The 56 main toroidal coils are in parallel as one element in a closed-loop system comprised of a holding tank, nitrogen-to-nitrogen heat exchanger, and centrifugal pump which circulates liquid nitrogen at 450 liters/min against a back pressure of 2.85 atm. The heat exchanger, which operates as a vertical thermosyphon reboiler, subcools the suction of the centrifugal pump to 80K from a maximum inlet temperature of 110K. The system is instrumented for automatic operation and has been in service for over 18 months, during which time over 3500 experimental plasma runs have been performed. A recently installed heat exchanger will provide subcooling of the pump discharge to 67K to allow yet-higher field operation than 25 kG. (auth)

15132 (CONF-730808-1) APPLICATION OF THE J-INTEGRAL TO OBTAIN SOME SIMILARITY RELATIONS. Chang, S. J.; Witt, F. J. (Oak Ridge National Lab., Tenn.). 1972. 16p. Dep. NTIS $3.00.

From 7th national symposium on fracture mechanics; College Park, Maryland, USA (27 Aug 1973).

For two linear elastic bodies geometrically similar to each other and of the same thickness, it is easy to show that the ratio of their total energies up to the time of fracture is equal to the ratio of their linear dimensions. Experimental evidence seems to suggest that this similarity condition in fracture energies may still exist for the specimens tested in their elastic–plastic range, independent of the amount of work hardening to be associated with the material. This result is shown, as well as a set of other similarity conditions, from the method of the J-integral. (MOW)

15133 (CONF-730903-1) CROSSFLOW-INDUCED VIBRATION OF A CIRCULAR CYLINDER IN WATER. Halle, H. (Argonne National Lab., Ill.). Dec 1972. 26p. Dep. NTIS $3.50.

From ASME design technical conference; Cincinnati, Ohio, USA (9 Sep 1973).

A circular cylinder elastically mounted to have equal flexibility in all lateral directions was exposed to cross (transverse) flow of water. The amplitudes and frequency of flow-induced vibrations were measured as a function of flow velocity. Resonance-type responses were observed when the vortex-shedding frequency coincided with one half (Condition A), and unity (Condition B) of the natural frequency of the cylinder. (MOW)

15134 (CONF-730904–3) APPLICATION OF DYNAMIC MEMBRANES TO DESALINATION OF BRACKISH WATER. Thomas, D. G. (Oak Ridge National Lab., Tenn.). 1973. 11p. Dep. NTIS $3.00.

From fourth international symposium on fresh water from the sea; Heidelberg, F. R. Germany (9 Sep 1973).

In 1969 J. S. Johnson and coworkers discovered that composite hydrous zirconium oxide-polyacrylic acid [Zr(IV)-PAA] dynamic membranes possessed good reproducibility, high fluxes, and good rejection at neutral pH. As a result, a small pilot plant was developed consisting of eight modules with total membrane surface of 40 ft^2. In the initial test with a full load of tube bundles, pretreated simulated Roswell, New Mexico, water was used as feed. With an axial velocity of 13.5 ft/sec and an inlet pressure of 1000 psig, average rejection of total dissolved solids was 90-91%, sulfate rejection was 93 to 95% and chloride rejection was 83 to 94%. The flux was over 100 gal/ft^2 day after two weeks of continual operation with little evidence for flux decline during that period. (auth)

15135 (COO–1552-104) AREA PROGRAM IN POPULATION GENETICS. Neel, J. V.; Gershowitz, H.; Bloom, A. D.; Sing, C. F. (Michigan Univ., Ann Arbor. Dept. of Human Genetics). 17 Apr 1973. Contract AT(11-1)-1552. 134p. Dep. NTIS $8.75.

This continues to be a broad program in population genetics, with particular emphasis on a multidisciplinary study of some of the remaining relatively unacculturated Indians of South America and on an effort to develop a "second look" at the children of survivors of the atomic bombings of Hiroshima and Nagasaki, this consisting of a search for an increase in mutations that influence protein structure and function. In addition, increased emphasis is placed on certain theoretical aspects of population genetics. Finally, the program continues to encompass a number of smaller projects in experimental population genetics and to support Bloom's continuing participation in the cytogenetic studies of the Atomic Bomb Casualty Commission. (auth)

15136 (COO–1599-65) CLOSE-INTERVAL FRACTIONATOR FOR SEDIMENT CORES. Fast, A. W.; Wetzel, R. G. (Union Carbide Corp., Tarrytown, N. Y. (USA); Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station). 1971. Contract AT(11-1)-1599. 9p. Dep. NTIS $3.00.

Well-consolidated sediments are easily fractionated by a thin blade either after the core sample has been entirely extruded, or as it is being extruded. However, many samples are too fluid to extrude or fractionate in this manner, and more complicated procedures must be employed. Sediments near the mud/water interface are often of this nature. In this regard, a rapid but simple device that fractionates core samples of a wide range of consolidation as they are extruded from the sampling tube was designed and tested. (auth)

15137 (COO-3254-13) GROWTH OF SALT MARSH MICROCOSMS SUBJECTED TO THERMAL STRESS. Saks, N. M.; Lee, J. J.; Muller, W. A.; Tietjen, J. H. (City Coll., New York. Dept. of Biology). 1973. Contract AT(11-1)-3254. 14p. (CONF-730505-5). Dep. NTIS $3.00.

From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

The effect of temperature on interspecific competition among representative salt marsh meiofauna and their grazing on algal populations is being studied. As the temperature is increased from 15 to 25°C, competitive effects are enhanced and blooms of particular species become more conspicuous. The survival of 12 species of algae that serve as food was investigated in more detail. The biothermal ranges of the 12 species of algae were also determined. (auth)

15138 (COO-3267-5) CHROMOSOMAL BANDING PATTERNS OF TWO PARACENTRIC INVERSIONS IN MICE. Davisson, M. T.; Roderick, T. H. (Jackson Lab., Bar Harbor, Maine). 1973. Contract AT(11-1)-3267. 14p. Dep. NTIS $3.00.

Banding techniques were used to study chromosomes of mice heterozygous for two genetically defined paracentric inversions, In(1)1Rk and In(2)5Rk. The banding patterns of the inversion-carrying chromosomes were altered as expected, and the relative lengths of the genetically and cytologically defined segments were comparable. (auth)

15139 (COO-3586-23) UPTAKE OF DNA BY BACTERIA AND EUCARYOTES. Tomasz, A. (Rockefeller Univ., New York). 1973. Contract AT(11-1)-3586. 25p. Dep. NTIS $3.25.

First, a brief description is given of the present status of knowledge in one of the better developed bacterial transformation systems, that of pneumococci. Second, attempts to introduce nucleic acids into eucaryotic cells are discussed. In dealing with both of these topics, the physiology of the recipient cell is emphasized. (auth)

15140 (JINR-E4-7150) MODEL SPIN HAMILTONIANS INCLUDING LONG-RANGE FERROMAGNETIC INTERACTION. Brankov, I. G.; Shumovskii, A. S.; Zagrebnov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

A thermodynamically equivalent Hamiltonian is constructed for a general spin-½ system including an infinitely long-range interaction of a ferromagnetic type. A rigorous proof is given for the thermodynamical equivalency. (auth)

15141 (KAPL-P-3955) EFFECTS OF COUPLED THERMOPLASTICITY WITH APPLICATIONS TO A HOLLOW SPHERE. Nied, H. A.; Batterman, S. C. (Knolls Atomic Power Lab., Schenectady, N. Y.). 1971. 34p. (CONF-730810-1). Dep. NTIS $3.75.

The thermoplasticity coupling phenomenon exhibited during cold working of an elastic–plastic solid is investigated by determining the stress redistribution that occurs due to heat generated during the dissipation of plastic work. An isotropic, homogeneous linear work-hardening material model is assumed, which follows Hooke's law in the elastic domain and the Prandtl–Reuss incremental relationship in the plastic domain according to a temperature-independent von Mises yield criterion. When coupled theory is applied to a spherical domain, the non-dimensionalization of the governing coupled partial differential equations introduces a new coupling parameter appearing as a coefficient to the dissipation term in the heat conduction equation. An approximate solution to these non-linear, coupled partial differential equations is obtained by using a perturbation series in terms of this coupling parameter which is called the thermoplasticity coupling parameter. (auth)

15142 (LA–5254-MS) SMALL PARTICLE STATISTICS. The Analysis of Particle "Size" Data. Lewis, H. D. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 20p. Dep. NTIS $3.00.

Fundamentals of "small particle statistics" are developed from basic statistical concepts applied to examples of analysis of idealized particulate systems. The development of methods for "particle size" data analysis is based on the form of the

data generated by various methods for measurement of "particle size distributions". It is shown that data can be classified into two general types. Methods for computing and comparing sample statistics are developed on the basis of Type I and II classifications for both functional and interval representations of the sample data. The compatibility of recognized statistical notation and definition with the problem of particle "size" analysis is demonstrated. (auth)

15143 (LA-5278-MS) DECAY OF OVERDRIVEN DETONATIONS IN NITROMETHANE. Fickett, W. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $3.00.

The decay rates of overdriven detonations initiated by Composition B and PBX9404 are calculated. These calculations were requested in connection with a proposal to use the measured rate of luminosity decay of an overdriven nitromethane detonation to obtain a qualitative picture of the profile of the initiating wave. (auth)

15144 (LA-UR-73-671) SELF-FOCUSING OF VERY POWERFUL LASER BEAMS. Suydam, B. R. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 9p. (CONF-730528-3). Dep. NTIS $3.00.

Self-focusing has heretofore been studied by assuming something equivalent to total collapse of the beam. Computer simulations at high power level show, however, that it is rather some small portions of the beam (e.g., a diffraction spike) that first collapses. Self-focusing was, therefore, examined as a problem in stability theory. The method can be applied to divergent beams and to any medium in which gain is a known function of field strength. The theory agrees well with computer experiments. One finds an absolute limit to the intensity available from a glass laser of near 10^{10} watts/cm^2. (auth)

15145 (LA-UR-73-821) APPLICATION OF FLOW MICROFLUOROMETRY (FMF) AND CELL-SORTING TECHNIQUES TO THE CONTROL OF ANIMAL DISEASES. Cram, L. S.; Forslund, J. C.; Horan, P. K.; Steinkamp, J. A. (Los Alamos Scientific Lab., N. Mex.). 1973. 40p. (CONF-730631-1). Dep. NTIS $4.00.

From symposium on rapid methods and automation in microbiology; Stockholm, Sweden (3 Jun 1973).

In this new method of analyzing cell populations, the cells are dispersed and suspended in a carrier liquid that flows past electronic and optical sensors where specific properties of each cell are quantitatively measured. The techniques of high-speed cell analysis and sorting by flow methods are described, along with the results of studies made on normal and abnormal cell populations. Applications include automated tumor cell identification; rapid analysis of white blood cells; a differential Newcastle disease virus assay; and detection of viral antigens. (CH)

15146 (LA-UR-73-832) CALIBRATION STANDARDS FOR COUNTING ASBESTOS. Ortiz, L. W.; Ettinger, H. J.; Fairchild, C. I. (Los Alamos Scientific Lab., N. Mex.). 1973. W-7405-eng-36. 12p. (CONF-730518-3). Dep. NTIS $3.00.

From AIHA conference; Boston, Massachusetts, USA (20 May 1973).

15147 (LA-UR-73-899) EVALUATION OF DIABETES BY OXIDATION OF ^{14}C- OR ^{13}C-LABELED GLUCOSE TO CO_2 IN VIVO. Shreeve, W. W.; Shoop, J. D.; Eaton, R. P.; Wu, C. H.; Roginsky, M. S.; Ott, D. G.; Gregg, C. T.; Uphoff, R. (Brookhaven National Lab., Upton, N. Y.; Los Alamos Scientific Lab., N. Mex.; New Mexico Univ., Albuquerque). 1973. 17p. (CONF-730309-9; SM-171/45). Dep. NTIS $3.00.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

15148 (NRC-TT-1624) ASSIMILATION OF PROTOCOCCOID ALGAE BY CYCLOPS. Monakov, A. V.; Sorokin, Yu. I. Translated from Byull. Inst. Biol. Vodokhran. Akad. Nauk SSSR; No. 3, 24-27(1959). 9p. Dep. NTIS (U. S. Sales Only) $3.00.

15149 (NRC-TT-1628) ADAPTIVE CHARACTERISTICS IN THE DEVELOPMENT OF THE SKIN AND ITS DERIVATIVES IN SEVERAL CETACEANS. Narkhov, A. S. Translated by Andrew Malysheff (National Research Council of Canada, Ottawa) from Uch. Zap., Mosk. Gos. Pedagog. Inst.; 186: 95-110(1962). 21p. Dep. NTIS (U. S. Sales Only) $3.25.

15150 (NRC-TT-1632) MAIN DIRECTIONS AND FUTURE DEVELOPMENT OF BIOLOGICAL METHODS OF FLY CONTROL IN KAZAKHSTAN. Dubitskii, A. M. Translated by V. Poppe (National Research Council of Canada, Ottawa) from Izv. Akad. Nauk Kaz. SSR, Ser. Biol.; 8: No. 2, 41-45(1970). 8p. Dep. NTIS (U. S. Sales Only) $3.00.

15151 (NYO-3995-22) TAXONOMIC IDENTITY AND PHYSIOLOGICAL ECOLOGY OF CHLAMYDOMONAS HEDLEYI (THE ALGAL FLAGELLATE SYMBIONT FROM THE FORAMINIFER ARCHAIAS ANGULATUS). Lee, J. J.; Crockett, L. J.; Hagan, J.; Stone, R. J. (City Coll., New York. Dept. of Biology; Brookhaven National Lab., Upton, N. Y.). 1971. Contract AT(30-1)-3995. 31p. Dep. NTIS $3.75.

15152 (ORNL-TM-4099) REACTIONS AND TRANSPORT PHENOMENA AT SURFACES. Water Research Program Biennial Progress Report for the Period March 15, 1966-March 15, 1968. Posey, F. A.; Moore, G. E.; Kraus, K. A. (comps.) (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 71p. Dep. NTIS $5.75.

The following topical reports are included here: Kinetics of Pitting Attack of Titanium in Chloride Solutions; Kinetics of Initiation of Crevice Corrosion of Titanium; Effect of Flow Rate on Efficiency of Oxidation-Reduction Reactions in Porous and Tubular Electrodes; Rectifying Properties of Valve Metals in a One-Compartment Electrolysis Cell; and Influence of Inert Electrolytes on Chronopotentiometric Constants. In addition, two items as reprints from the open literature are included: (1) Pitting of Titanium Alloys in Saline Waters, and (2) Chronopotentiometry of the Ag-AgCl System and Analysis for the Chloride Ion. (LMT)

15153 (ORNL-TM-4137) SiO_2 SCALE FORMATION IN SIMULATED GEOTHERMAL BRINE. Harley, P. H. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 21p. Dep. NTIS $3.25.

An experimental single-tube, upflow vertical tube evaporator (VTE) was operated in the temperature range 290 to 355°F to determine the effect on heat transfer of SiO_2 dissolved in a simulated geothermal brine. With 800 ppM dissolved SiO_2, an amorphous scale deposited on the inside wall of tube. This reduced the overall heat transfer coefficient to 30 to 50 percent of the original value. There was no obvious effect of temperature or of brine-to-vapor ΔT in the range 5 to 20°F. The scale was determined to be essentially all SiO_2. It was removed by circulating demineralized water overnight. Scale was observed to form both in the presence of Ca and Mg and in their absence. (auth)

15154 (ORNL-TM-4246) MAPPING OF POPULATION DENSITY. Haaland, C. M.; Heath, M. T. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $4.00.

The method and results of obtaining population density maps of the U. S. without attempting to calculate the areas of enumeration districts are described. The results are not exact, but the accuracy is sufficient for many purposes, such as for evaluation of population risk from nuclear war or natural disaster, and for planning evacuation routes from urban areas. (LMT)

15155 (ORNL-TM-4293) OZONE FORMED BY HIGH-VOLTAGE TRANSMISSION LINE CORONAS. Davis, W. Jr. (Oak Ridge National Lab., Tenn.). 2 Jul 1973. 7p. Dep. NTIS $3.00.

15156 (ORO-4057-3) DETERMINATION OF THE CELLULAR AND SUBCELLULAR LOCALIZATION OF ^{125}I- AND RADIOACTIVELY LABELED THYROID HORMONE IN THE THYROID, PITUITARY, AND HYPOTHALAMUS. Technical Progress Report, October 1, 1972-June 30, 1973. Stumpf, W. E. (North Carolina Univ., Chapel Hill. Dept. of Pathology). 1973. Contract AT-(40-1)-4057. 39p. Dep. NTIS $4.00.

15157 (RFP-2014) ELECTRONIC CONTROL FOR INTERFEROMETRIC INSPECTION GAGE. Gunderson, D. E. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 18 May 1973. Contract AT(29-1)-1106. 9p. Dep. NTIS $4.00.

Two gaging systems were developed for the inspection of machined hemispherical parts. Both systems use the same optical-gaging arrangement. The data processing and control electronics for the first system required numerous operator manipulations and calculations before and during a part inspection involving lengthy inspection periods. In the revised electronics package, many manipulations and calculations were eliminated and resulted in manhour savings by shortening and simplifying part inspections. (auth)

15158 (SAN-899-X-1) DIRECT, LONG-TERM OBSERVATION OF HEMATOPOIETIC MARROW. Progress Report, July 1, 1972-July 15, 1973. (Scripps Clinic and Research Foundation, La Jolla, Calif.). 1973. Contract AT(04-3)-899. 7p. Dep. NTIS $3.00.

15159 (SC-WD-66-142-C) ENVIRONMENTAL DATA BANK INDEX: UNCLASSIFIED ENTRIES. Gens, M. B. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 52p. Dep. NTIS $4.75.

In an effort to determine the environment to which the equipment designed by Sandia Laboratories will be exposed, a data bank of environmental information has been compiled. Measured quantities resulting from field tests or actual use are continually being summarized to establish envelopes of inputs and responses. This material is being collated, microfilmed, and filed under 15 basic categories of environment. By consulting this data bank, a user has at his immediate disposal numerical definitions of the environments to aid in establishing design requirements and test plans. (auth)

15160 (SLA-73-550) SUPERELASTIC COLLISION OF ELECTRONS AND METASTABLE HELIUM ATOMS (2^3S) IN A ROOM TEMPERATURE HELIUM AFTERGLOW. Johnson, A. W.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 13p. Dep. NTIS $3.00.

15161 (SLA-73-553) BIBLIOGRAPHY ON VACUUM SWITCH TUBE, VACUUM ARC, AND VACUUM BREAKDOWN LITERATURE. Grissom, J. T. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 48p. Dep. NTIS $3.00.

This bibliography consists of references describing vacuum switch tubes and related vacuum arc and vacuum breakdown phenomena. The vacuum switch tube literature is subdivided into two major categories: Triggered Vacuum Switch Tubes and Other Types of Vacuum Switch Tubes. The vacuum arc literature is subdivided into the major categories of Cathode Phenomena, Anode Phenomena, and Plasma Phenomena. A separate section is devoted to references dealing with vacuum breakdown phenomena. The references are listed within each section in chronological order. (auth)

15162 (SLA-73-5283) MECHANISMS CONTROLLING THE DECAY OF THE 1730 Å CONTINUUM OF XENON RADIATION. Johnson, A. W.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). 1972. 4p. (CONF-730906-3). Dep. NTIS $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

15163 (SLA-73-5284) EFFECT OF METASTABLES ON THE TRANSITION FROM AMBIPOLAR TO FREE DIFFUSION: He-Ar MIXTURES. Gerber, R. A.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). 1973. 4p. (CONF-730906-1). Dep. NTIS $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

Temporal measurements of the electron density and ion wall currents in helium-argon mixtures in which Ar^+ is the dominant ion show that the transition from ambipolar to free diffusion is identical to that previously measured in pure helium. This establishes that helium metastables did not influence the decay of the electrons and ions as was suggested by Gerber and Gerardo and thus cannot account for the difference between experiment and theory. The zero field mobility of Ar^+ in He was found to be $\mu_0 = 22.4\ cm^2\ volt^{-1}\ sec^{-1}$. (auth)

15164 (SLA-73-5285) 1730 Å LASER TERMINATING ON A DISSOCIATING LEVEL. Johnson, A. W.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 4p. (CONF-730906-4). Dep. NTIS $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

15165 (UCB-34-P-186-X-3) RECOVERY AND ANALYSIS OF MUTANT CONTROLLING DEVELOPMENT OF DROSOPHILA MELANOGASTER. Progress Report. (California Univ., Berkeley). 1972. Contract AT(04-3)-34. 12p. Dep. NTIS $3.00.

15166 (UCID-16278) WAVEGUIDE MODES GENERATED AT A PIPE SIZE DISCONTINUITY. Cooper, R. K.; Neil, V. K.; Briggs, R. J. (California Univ., Livermore. Lawrence Livermore Lab). 21 May 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

The rf fields generated by a long, sinusoidally modulated, relativistic electron beam as it passes from one size of conducting pipe to another are studied. The electric and magnetic fields traveling with the beam are assumed to be quasi-static, e.g., $E_{r\ beam}(r,z,t) = 2\lambda(z,t)/r$, where λ is the linear charge density of the beam. In the region of the discontinuity this radial field alone would give a non-zero tangential electric field on the flange surface (the surface connecting the two pipes perpendicular to the pipe centerline). It is assumed that waveguide modes in the two pipes, generated at this discontinuity, contribute radial electric fields that just cancel the field of the beam over the flange surface. Only azimuthally symmetric waveguide modes, appropriate to a centered beam, are considered. (auth)

15167 (UCID-16291) FAILURE OF A FIXED-CORE MODEL OF THE XENON MOLECULE TO DESCRIBE THE $^1\Sigma_g$, $^1\Sigma_u$, and $^3\Sigma_u$ STATES. Bevensee, R. M. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Jun 1973. Contract W-7405-eng-48. 13p. Dep. NTIS $3.00.

15168 (UCLA-34-P-102-35) OCCURRENCE AND CHARACTERISTICS OF A RAPID EXCHANGE OF PHOSPHATE OXYGENS CATALYZED BY SARCOPLASMIC RETICULUM VESICLES. Kanazawa, T.; Boyer, P. D. (California Univ., Los Angeles). 1972. Contract AT(04-3)-34. 54p. Dep. NTIS $4.75.

It was demonstrated that sarcoplasmic reticulum vesicles catalyze a rapid $P_i \rightleftharpoons HOH$ exchange, which can be reasonably attributed to the reversal of steps in the process associated with calcium transport driven by ATP hydrolysis. The characteristics of the $P_i \rightleftharpoons HOH$ exchange recently found in Na^+, K^+-ATPase of cell membranes are quite similar to those of sarcoplasmic reticulum vesicles. This suggests mechanistic similarities between the two transport systems. (13 figures, 3 tables, 43 references) (LMT)

15169 (UCRL-74265) MASS-CONSISTENT WIND FIELD MODEL FOR THE SAN FRANCISCO BAY AREA. Dickerson, M. H. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Apr 1973. 27p. (CONF-730537-1). Dep. NTIS $3.50.

From WMO/IAMAP symposium; Reading, England, UK (14 May 1973).

The objective was to adjust the wind and the height of the inversion base above topography such that the air mass is conserved and the observational data are changed in a minimum way. In other words, a surface of constraint is fitted to the observations in a least-squares sense. The resulting equations lend themselves to rapid numerical solution by computer. (auth)

15170 (UCRL-74744) RATIONAL DEFINITION OF INDEX NONLINEARITY IN SELF-FOCUSING MEDIA. Glass, A. J. (California Univ., Livermore. Lawrence Livermore Lab.). 11 May 1973. 9p. (CONF-730528-1). Dep. NTIS $3.00.

It is proposed that the index nonlinearity in self-focusing media be reported in terms of a critical power for the medium, P_1, rather than in terms of n_2. The principal results of a self-focusing theory are expressed in terms of the ratio (P/P_1), where P is the total power in a Gaussian beam. Using P_1 not only simplifies the expressions for quantities of physical interest, but also will remove some of the confusion now existing in the literature of self-focusing and laser damage. (auth)

15171 (UCSD-34-P-150-X-2) GENETIC CONTROL OF GAMETOGENESIS IN DROSOPHILA MELANOGASTER. Progress Report, May 1972-May 1973. (Scripps Institution of Oceanography, La Jolla, Calif.). 1973. Contract AT(04-3)-34. 4p. Dep. NTIS $3.00.

15172 (USC-113-P-19-37) INVARIANT IMBEDDING AND CHANDRASEKHAR'S PLANETARY PROBLEM OF POLARIZED LIGHT. Mukai, S.; Ueno, S.; Wang, A. P. (University of Southern California, Los Angeles. Dept. of Electrical Engineering). Dec 1972. Contract AT(40-3)-113. 19p. (CONF-721145-1). Dep. NTIS $3.00.

From IAU colloquium 23 on polarimetry in optical astronomy; Tucson, Arizona, USA (15 Nov 1972).

A solution is given for the equation of transfer for Chandrasekhar's planetary problem of polarized light, i.e., the diffuse reflection and transmission problem of polarized parallel rays by finite atmospheres bounded by reflecting surfaces. The bottom surface is assumed to reflect radiation either isotropically or specularly. A Cauchy system for the scattering matrix of planetary problem and the radiation field vector in the case of internal emitting source are presented, together with the initial conditions. Finally, the order-of-scattering theory of polarized light is shown. This theory facilitates the numerical computation, by successive iteration, of radiation emergent from the top of the planetary atmosphere. The characteristic of the invariant-imbedding technique is to transform the two-point boundary value problem into the initial-value problem. The initial-value problem of Riccati type is suitable for the numerical computation with the aid of the high-speed digital computers. (auth)

15173 (Y-DK-108) DETERMINATION OF MOCA IN ADIPRENE MOCA MIXTURES BY GEL PERMEATION CHROMATOGRAPHY. Williams, N. J.; Morrow, R. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 Jul 1973. Contract W-7405-eng-26. 12p. Dep. NTIS $3.00.

The concentration of 4,4'-methylenebis[2-chloroaniline] (MOCA) in adiprene L-100 as a function of room temperature curing time was determined. Mixtures of 10 parts, 13 parts, and 26 parts MOCA per 100 parts adiprene were prepared and analyzed using gel permeation chromatography. The 10:100 mixture required 1 h for the MOCA concentration to reach 4 wt % and 5 h

for the concentration to reach 1 wt %. After 1 h, the MOCA content of the 13:100 mixture decreased to 5 wt % and after 6 h it had decreased to 1 wt %. The MOCA concentration of the 26:100 mixture decreased to 7.5 wt % after 1 h and 3.9 wt % after 24 h. (auth)

15174 COMPUTER IMAGE ENHANCEMENT TECHNIQUES FOR MEDICAL RADIOGRAPHS. Hall, E. L. (Yale Univ., New Haven). Trans. Amer. Nucl. Soc.; 16: 47-48(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

15175 COMPUTER PROCESSING OF DIGITAL IMAGES FOR RADIOGRAPHIC APPLICATIONS. Brooks, R. C.; Ausherman, D. A.; Dwyer, S. J.; Lodwick, G. S. (Univ. of Missouri, Columbia). Trans. Amer. Nucl. Soc.; 16: 48-49(Jun 1973).

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973). See CONF-730611-.

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